East Case
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This is the most important work upon Navigation that had yet appeared in the world. The science was revolutionized by it. Very few copies have the map in which the New World is delineated on the same sheet with the western parts of Europe and Africa.

bought of Boone

CORTES (Martin). The Arte of Nauigation. Conteyning a compendious description of the Sphere, with the making of certayne Instruments . . . Englished out of Spanishe by Richard Eden . . . At London printed, at the charges of Richard Watkins. 1589. Sm. 4to., *with a folding chart of the Northern Atlantic including the New World, and woodcuts of spheres, etc. with the volvules* 1589

BOURNE (William). The Arte of shooting in great Ordnaunce . . . Imprinted at London for Thomas Woodcocke. 1587. Sm. 4to., *with* 15 *woodcuts* 1587

GARCIE (Pierre). Le Grand Routier, Pilotage, et Encrage De Mer: Tant Des Parties De France, Bretaigne, Angleterre, que haultes Alemaignes . . . A La Rochelle, Pour Marin Villepoux. M.D.LXXXIIII. Sm. 4to., *with* 60 *woodcuts of outlines of headlands, islands, etc.* 1584

— the three works together in 1 vol., sm. 4to., *vellum, with the arms of Henry, ninth Earl of Northumberland* 1584-9

All of the above are fine perfect copies. The science of Navigation was revolutionized by the publication of Cortes Arte of Nauigation, which contained many new methods of ascertaining latitude, etc. In the majority of copies the volvules belonging to the diagrams are missing. It seems probable that this volume, belonging to the ninth Earl of Northumberland and concerning mathematics and voyaging, formed part of the library which the Earl had with him during his imprisonment in the Tower. He had there as a fellow prisoner Sir Walter Raleigh, who was a personal friend.

THE Arte of Nauigation.

Conteyning a compendious description of the Sphere, with the making of certayne Instruments and Rules for Nauigations, and exemplifyed by many Demonstrations.

Written by MARTIN CORTES *Spanyarde.*

Englished out of Spanishe by RICHARD EDEN, and *now newly corrected and amended in diuers places.*

At London printed, at the charges of Richard Watkins. 1589.

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H.B. 4 June 1917
3 May 1927

¶ To the ryght woorshipfull Syr *Wylliam Garerd Knyght, and Maiſter Thomas Lodge,* Aldermen of the Citie of London, and gouer-*nours of the honorable Felowſhip or Societie,* as well of certayne of the Nobilitie, as of Merchants Aduenturers, for the diſcouery of Lands, Territories, Ilands, & Signories vnknowen, and not before their fyrſt aduenture or enterpryſe by Sea or Nauigation commonly frequented.

And to the ryght Worſhipfull the Conſulles, Aſſiſtents, and Comminaltie of the ſame Societie, RICHARD EDEN *wyſheth health and proſperitie.*

WHat ſo euer he was (right Honorable and Woorſhipfull) that firſt beleeued that the frame and coaptation of the body of man, with the functions, offices, and dueties of the partes and members of the ſame, knit togeather in a certayne vnitie to a common miniſtration, did repreſent a liuely image & ſimilitude of a perfect Common wealth: I thinke that he was a man of no vulgar iudgement, or obiect minde, but rather of ſinguler wiſedome and prudence, in the contemplation of diuine & humane things. For he ſawe, that as in the ſmall natiue ſeede of all growing or liuing things, is conteined the fourme that bringeth them to theyr perfection: ſo in certayne ſmall and obſcure members of the Common wealth, conſiſteth no ſmall encreaſe to the perfection of the whole. He ſaw lykewiſe, that heerein, as in the body of man, repreſenting the partes and members of the world (as I haue ſayde) are dyuers parts of diuers and ſundry actions & motions, greatly differing in fourme,

number, and quantitie, yet all the same to be so knit togeather, and so to consent in one vniformitie, to the common profit of the whole, that a greater concord & harmonie can not be imagined, then is proportioned by the friendly vnitie of diuers and contrary. He saw likewise in the same, such a mutuall compassion of part to part, and member to member, by one common sense existent in them all, that no one part or member can feele eyther ioy or payne, but that in manner all the other are partakers thereof more or lesse, yf they be liuely members, and not withered, or otherwise vnsensate by reason of dead flesh, which only by cutting and burning ought to be diuided from the sound and whole. But as in man (whome *Plato* calleth the lesse world) the vigour and agilitie of the immortall soule and minde neuer ceasseth from continuall mooving, but is euer exercised in excogitations & inuentions of great things (herein resembling God, whose caract it beareth) by prouidence foreseeing, and by intelligence vnderstanding, and deuising what is to be done, and what to be eschewed, doth immmediatly mooue and rayse vp the faculties, powers, and members of the body to execute the same: Euen so, in the greater world, the prouidence of God, and vniuersall counsayle and consent of men, hath elected & appoynted certayne principall men, to beare like rule & aucthoritie in the body of the Common wealth, as hath the intellectiue soule in the members of our body to mooue and commaund the same. To Princes therefore, Counsaylours, Rulers, Gouernours, and Magistrates, as to the most intellectiue and sensitiue partes of the societie of men, hath God and Nature geuen preeminence and gouernaunce of the Common wealth, that by their prouidence, wisedome, and ayde, it may vniuersally florishe, not only by iust administratiō of good lawes, with due correction of malefactours, but also by lyberall rewarding of suche as haue well deserued, and especially by mayntenance of such Artes and Sciences, as the Common wealth can not well be without. And to drawe nearer to the applying of my similitude, I say, that what so euer Vertue, what so euer Arte,

or

or the ingenious industry of men, hath to this day inuented, all the same is to be imputed to the beneuolence and liberalitie of such as haue honorably mainteyned, and freely rewarded the trauayles, paynes, and charges of them that haue spent theyr lyues, goodes, and wits (as many haue done) in the inuentions of necessarie and profitable Artes and Sciences. For euen as wholesome and temperate ayre, with seasonable weather, and fauourable influence of the heauens and planets, causeth fruitefulnes on the earth, and contrarywise, barrennes by the contrary: Euen so the fauour of Princes and Magistrates, nourisheth, augmenteth, and amplifyeth, all Artes and Sciences by liberalitie, and extinguisheth the same by miserable couetousnes and parcimonie. And although in some men of rare and noble nature, the desyre of honor and fame, only for vertues sake, and studie towarde their Countrey and Common wealth, haue mooued them (in maner to their owne vndoing, through their great losse and hinderance) to set foorth and inuent diuers thyngs for the commoditie of the common wealth, and other, rather then for their owne: yet vndoubtedly, who so well consydereth, and indifferently wayeth that I haue sayd, shall fynde and see by dayly experience, that in maner onely munificence, liberalitie, and reward, or the hope thereof, geueth spurres to them that attempt great and vertuous enterprises, as I could more largely proue by so many testimonies of hystories, both holy & prophane, that the rehearsall therof should be but tedious, and not greatly necessary for my purpose, especially writing vnto your Honors and Worships, of whose munificence, and liberalitie, I haue had great experience, both in my selfe, and others, who by your ayde and mayntenance, haue attempted, & perfourmed many goodly inuentions, vyages, nauigations, and discoueries of lands and seas, heretofore vnknowen. Wherein, what great charges you haue susteyned, and how liberall and constant you haue been in furthering the same, doth well declare, that hytherto you are rather losers then gayners thereby. The which thing doubtlesse, is more to your commendation, in

that it may heereby appeare that you haue attempted the ſame, rather for knowledge and vertues ſake, then for couetouſneſſe of gaynes: as is furthermore well knowen by your fyrſt vyages of diſcouerie attempted to *Cathay*, by the Northeaſt ſeas, vpon certayne loſſe and detriment, for vncertayne hope eyther of gaynes, or of any ſuch way to be found, otherwiſe then by certayne likely coniectures: not much vnlike to the ſhining flowres of Marchaſytes, which outwardly appearing in minerall mountaynes, are ſignes and tokens whereby is coniectured what metall is contayned therein, and whether the ſame be to be folowed or not. And although it ſometime ſo chaunce, that ſuch ſignes are fayleable, ſhewing more in apparance, then they contayne in ſubſtance: yet are not ſuch ſignes, tokens, or ſhewes to be contemned, but rather earneſtly to be folowed, for as much as it hath been often prooued, and found by experience, that by folowing the ſame, haue been found great and ryche mynes of mettalles, as *Georgius Agricola* in his bookes *De rebus metallicis*, dooth largely declare and prooue by many examples. But to write at large what great things haue proceeded of ſmall and obſcure beginnings, and in manner meere coniectures, it would ſo farre exceede the meaſure of an Epiſtle or Preface, that it would rather encreaſe to the iuſt quantitie of a booke. For in manner all the late diſcoueryes both of the Spanyards and Portugales, had theyr beginnings of ſuch ſmall coniectures, with vncertayne hope (as it were *praeter ſpem ſub ſpe*) vntyll God and good happe, by the conſtant trauayle and valiant minde of ſuch as fyrſt attempted the ſame, gaue them to enioy that they hoped for. But what ſo euer they haue obteyned, and do enioy, this may I boldly ſay in your behalfe (right Honorable and Worſhypfull) that there hath not lacked in you, eyther the lyke or greater promptneſſe of minde, forwardneſſe in attempting, magnificence in expences, or liberalitie in rewardes. For beſyde the great charges, and loſſes that you haue been at other vyſe, what ſhould I ſpeake of the great giftes that you haue ſent to the Emperour of Ruſſia? What

of

of your laſt chargeable vyage of diſcouerie among the innumerable Rockes, Ilandes, and moueable mountaynes of yſe in the froſen ſea, by innumerable lands and Ilands vnknowne to the Antiques, euen vnder and farre within and beyond the circle Articke, where they thought that no lyuyng creature coulde drawe breath or lyfe for extreeme colde? whereas neuertheleſſe the ſame hath been by you diſcouered, euen vnto the mightie ryuer of *Ob*, that falleth into the Scythian Ocean, or *Oceanus Hyperborei*, not farre from the mountaynes called *Hyperborens*, ſo named, becauſe they are ſituate almoſt vnder the North Pole, and thought therefore to be inacceſſible. A voyage doubtleſſe of ſuche difficultie, and in maner impoſſibilitie, that conſidering the infinite dangers thereof (as I haue learned by the information of *Steuen a Burrough*, that was then the chiefe Pilot of the ſame voyage) it may ſeeme impoſſible that they ſhould euer haue eſcaped, except the mightie hand of God, by the expert skylfulneſſe of ſo excellent a Pilot, had deliuered thē from thoſe dangers. And although in deede (as religion bindeth vs) it is conuenient in all things to geue all honour, glory, and thanks to God: yet are we not thereby reſtrayned to be thankefull to ſuch men, as by theyr arte, ingeniouſneſſe, trauayle, and diligence, haue deſerued both iuſt commendation, and large rewarde. And therefore referring the reward to you (right Honorable & Worſhipfull, to whome it apperteyneth) if I ſhould not heere geue him at the leaſt ſuch commendation as in my iudgement he hath well deſerued, I might ſeeme both to defraud him of his woorthy deſerts, and alſo to forget the friendſhip and good will I beare him, only for his vertues and excellencie in his profeſſion. For certainely when I conſider how indigent and deſtitute this Realme is of excellent and expert Pilottes, I can doo no leſſe of conſcience, then, in reſpect of your owne commoditie, yea rather for the commoditie of the Queenes Maieſtie, and the whole Realme, to exhort you, and put you in remembrance (although I may heerein ſeeme to put the Spurres to a running Horſſe, as ſayth the Prouerbe) ſo to

regard hym, and esteeme hym, and his faithfull, true, and paynefull seruice toward you, that he may thereby be further encouraged, and not discouraged, eyther for lacke of mayntenance, or otherwise by the iniurious assaults of such his enimies, as onely his vertues and excellency haue moued to beare him displeasure: as enuie doeth euer follow vertue, as sayth the Latine Prouerbe, *Virtuti comes inuidia*. And how true a sentence this is, is well verified by the saying of a certayne Philosopher (whose name I do not remember) who hearing one vaynely reioyce that he had no enimies, answeared, that that was a token he had done little good: meaning thereby (as dayly experience proueth) that if he had excelled in any vertue, he could not haue lacked some enimies. And hauing here touched to speake of enuie, I remember that when I was a young Scholler, I haue read in the Poet *Hesiodus* of two kyndes of enuie, whereof the one is called *Inuidia*, and the other *Aemulatio*, which is more tollerable then the first, for that it is ioyned with some vertue, and enuyeth that any should excell him in any excellent qualitie that he professeth. But for asmuch as this enuie of emulation proceedeth of some singuler vertue of them that are so maliced, they may herein reioyce, that they shall euer haue a hundred freends for one enimie: yea, and although they had none, yet is vertue a reward to it selfe, and to bee embraced for it selfe onely, as the Philosophers affyrme. What then shall we say to such, as forgetting this reward of vertue, do not onely fauour, but rather hynder the preferment and mayntenance of such expert men, more esteeming certayne Fyshermen that goe a trawling for fysh in Catches, or Mongers, and Dradgies for Oysters about the sandes, betweene the South furland and Wyntertonnesse, and the sandes about Temmes mouth, then they doo suche excellent Pilotes as are able without any Rutter or Carde of Nauigation, not onely to attempt long and farre vyages, but also to discouer vnknowen lands and Ilandes, as haue done of late yeeres many excellent men, to the great honor and enriching of theyr Prince and Countrey. But as touching

ching *Stenen a Burrough*, the chiefe Pilot of your vyages of discouery, it may hereby well appeare, that he is neyther malitious nor enuious of his Arte and Science, in that hee desireth the same, for the common profite, to be common to all men: and for the same intent was the first that moo-ued certayne Worshipfull of your company, as Syr *Wyllyam Garrerd*, Mayster *Wyllyam Mericke*, Mayster *Blase Sanders*, and Mayster *Edward Castlen*, to haue this worke translated into the Englishe tongue: Who of theyr owne good nature, fauouring all vertuous studies, and the professours of the same, did soone enclyne to his honest requeste heerein, and therewith not onely desired me, but also with liberall rewarde enterteyned me, to take in hand the translation. Which beyng now finished as well as my poore learning may perfourme, I desyre your Honors, and Worships, to accept in good part, as I haue meant heerein to gratifie you, and doo such seruice as my abilitie may suffice. Now therefore thys woorke of the Art of Nauigation, being publyshed in our vulger tongue, you may be assured to haue more store of skilfull Pilots. Pilots, (I say) not Pirots, Rulers, nor Rouers, but such as by their honest behauiour and conditions, ioyned with art and experience, may do you honest and true seruice: Which is not to be looked for of such as being destitute aswell of the feare of God, as of all morall vertues, superabound in all notorious vices, accompting desperatnesse for boldnesse, rashnesse for hardines, impudencie for stoutnesse, and crueltie for manhood. What other thing (I say) is to be looked for of such, then of such trees, such fruites, *Et mali corui, malum omen.* But forasmuch as these haue no place appoynted them in the body of our common wealth, which we haue herebefore compared to the members of the body of man: therefore are they no otherwise to be esteemed, then as excrements of the body, to whome Nature hath appoynted no place in the same, but labcureth continually to cast them foorth diuers wayes, least by their filthynesse they should infect the other members, euen as the pompe of the Shyp, if it be not auoyded, is noyous to the

Ships,

Ship, and all that are therein. But the wise and honest Pilotte, fyrst hauing before his eyes the feare of God, and putting his chiefe trust in him, shall secondarily trust in his Arte and Science, without any such vaine obseruations, as the superstitious Horoscopers (Astrologiers I meane, and not Astronomers) are accustomed to vse in the elections of houres, times, and dayes, by constellations and aspectes of the Starres and Planets, as many fond men haue done, thynkyng thereby to haue escaped such dangers, as they haue thereby the rather fallen into, through contempt of Arte and Science, by fooliſh confidence in superstitious Astrologie: which for the vanitie and vncertaintie thereof, the ryght Worshipfull, and of singuler learning in all Sciences, Syr *Thomas Smyth*, in my time the flowre of the Vniuersitie of Cambridge, and sometyme my Tutor, was accustomed to call *Ingeniosissimam artem mentiendi*, (that is) The most ingenious arte of lying. Omitting therefore the superstitious and phantasticall obseruations of the iudicials of Astrologie, it shalbe better and more necessarie for all Pilottes that desyre to excell in their profession, to learne and obserue the principles of this Booke, whereby they may haue such knowledge of the Sphere, as may instruct them the making and vse of diuers goodly Astronomicall instruments pertayning to the arte of Nauigation, by knowledge of the mouings of the Sunne and Moone in their Spheres, and the other Planettes and fyxt Starres: thereby to attayne to the true knowledge of houres, tymes, and tydes, with the variation of the Compasse, and many other goodly naturall obseruations of weather, tempestes, and calmes, by certayne infallible signes and tokens of the same, very necessarie to be obserued, and this by the true principles of Astronomie, and not of Astrologie. And this is the true Astronomie, whereof the diuine Philosopher *Plato* hath written so diuine a sentence, that I haue thought the same heere woorthy to be alleaged, that by the authoritie of so famous an authour, we may know what is true Astronomie, with the vse and commoditie thereof. Therefore in his booke entituled

tuled *Timeus vel de Natura*, these are his words.

Rerum autem optimarum cognitionem, nobis oculi attulerunt. Nam hæc quæ de mundo disputantur, nunquam inuenta fuissent, si neque Sydera, neque Sol, neque Cœlum, suscipe potuissent. Cognitio vero diei ac noctis, ab oculis orta, fecit vt dimensione quadam mensium, annorumque ambitus metiremur, tempus cognosceremus, ac vniuersæ naturæ ordinem scrutaremur. Quibus ex rebus, Philosophiam adepti sumus.

That is to say, Our eyes haue brought vnto vs the knowledge of most excellent things. For whatsoeuer is disputed of the world, had neuer been inuented, if neyther the Starres, neyther the Sunne, neyther Heauen, could haue been seene. For the knowledge of the day and nyght, taking beginning at the eyes, caused vs, as it were by certayne limits and boundes, to measure the circuites of monethes and yeeres, whereby we came to the knowledge of tymes, and the order of vniuersall nature. And heereby also we obteyne the knowledge of Philosophie. &c. And thus by the authoritie of diuine *Plato*, (whome for his excellencie *Cicero* called *Deum Philosophorum*, that is, the God of Philosophers) we may vnderstande, that the true Astronomie, is the perfect knowledge of the miraculous mouings of the Planets, Stars, and heauens (and especially of the Sunne and Moone) whereby is caused the varietie of times, and diuersitie of all naturall things, by naturall causes: as by the qualities of Eleméts, as hote, colde, moyst, and dry, which are augmented or diminished by the more or lesse influence of these two Luminaries, as they come neere vnto vs at sometimes, or depart farther frō vs at other times, with diuers motions in diuers climates, which causeth not only varietie of tymes in sundrie climates, but also the varietie of diuers complexions, fourmes, and dispositions of all creatures vnder the face of heauen, none other accidentall, contingent, voluntarie, or violent cause, to the contrary notwithstanding. And this is it that *Plato* meaneth by these woords, *Vt tempus cognosceremus ac vniuersæ naturæ ordinem, &c.* That is, to knowe the tymes and vniuersall order of nature. And doubtlesse,

who

who so well consydereth the marueylous effectes that are caused, especially by the variable moouing of the Sunne in the Zodiacke, must needes ackuowledge it to be the chiefe instrument and meane that God vseth in the generation, preseruation, and alteration of all creatures that are conteyned in the world of generation and corruption. And for this consyderation, certayne of the auncient Philosophers called it the soule of the world: Other, the eye: and other also the hart of the world. *Plato* also affyrmeth, that the soule of the world is the Sunne, and that all other lyuing things receiue lyfe from thence. And hereof commeth the saying of the Philosopher, *Sol & homo, generant hominem*: (that is) the Sunne and man, beget man. And therefore (as wryteth *Marcilius Ficinus*) of all Idolaters they are most tollerable that honor the Sunne for God. The which, although it be not, yet vndoubtedly are his effects so great and wonderfull in this inferiour world, that it may seeme in manner to be Gods Vicegerent, Liefetenant, and Viceroy, in all the works of nature, except where and when it pleaseth him in any thing miraculously, otherwise then by the common order and course of nature, to commaund the contrarie.

And if it may not be tedious vnto you (right Honorable and Worshipfull) it shalbe a pleasure vnto me, for the better declaration hereof, to make a briefe discourse of the marueylous and strange effects that are caused by the Sunne: which perhaps few haue done, otherwise then dispearsedly here and there, as occasion hath serued. Fyrst therefore let vs consyder what it hath done ouer the Equinoctial lyne, and vnder both the Poles at one instant, diuersly and contraryly the one to the other. For so hath the infinite wisedome of the great God of nature, the supreame Architecture of the vniuersall world, disposed all things in such perfect order, that to them that are vnder the Equinoctial, and haue theyr Horizon passing by the two Poles, the day is of twelue houres, and the nyght as much, and theyr yeere also is deuided into twelue monethes: But they that dwell iust and perpendicularly vnder our Pole, and that haue theyr

Horizon

Horizon passing ouer the sayd lyne, haue the day of the sixe monethes: That is to say, beginning from the tenth day of March, when the Sunne commeth ouer the sayde Horizon, vntill it returne to passe vnder the same at the tenth of September. And contrarywyse, one night of sixe moneths haue the inhabitantes vnder the Pole Antarticke: whose yeere (that is to say, all the course that the Sunne maketh by the twelue signes of the Zodiacke) is accomplished in one day and one nyght: a thing doubtlesse most wonderfull and marueylous. Lykewise, when we haue sommer, they that are vnder our Pole, haue the day of sixe monethes, and they of the opposite or contrary Pole, haue their night of the same length. Againe, when it is winter with vs, then vnder our Pole is the night of the said sixe monethes, and vnder the opposite Pole, is the day of the same length. So that, as it were, course by course, when we haue the night, they haue the day: and contrarywyse, whē we haue the day, they haue the night. The which, although it be so long, & of so great space of time, yet is it not continually obscured with darkenesse. For the Sunne maketh his course in such order, that the inhabitants of that part, liue not during that time altogeather in darknesses, as Moles liue vnder the ground, but as other creatures that liue vpon the globe and face of the Earth, they haue such lyght as may suffyse to susteyne and mayntayne their life. For the body of the Sunne declyneth no more either beneath the Equinoctial line, either aboue the same line (which is the Horizon to both the Poles) then 23. degrees, that is to say, no lower or higher then the Tropikes, which are no more then 23. degrees, or there about, from the sayd Equinoctial, that is their Horizon, as is aforesayd. And yet in these 23. degrees, he maketh not his course by the opposite Diameter, but goeth continually round about in circuite: so that his beames reuerberating heauen, represent such a manner of lyght, as wee haue in Sommer two houres before the Sunne rise. And this example whiche we haue taken of the diuersitie of the Horizons of the Equinoctial, and vnder the two Poles, is to demonstrate the

marueylous

marueylous effect that the Sunne maketh, departing from the xij. houres of the Equinoctiall (that is to say, from *Aries* to *Libra*) and comming by lytle and lytle, illuminating the Globe of the earth, and so reducing the yeere of xij. monethes, into one onely day, and one night, as is sayd before. Vnder the infinite varietie of the which course, sometyme with long dayes, and sometime with short, all the Inhabitants of the world are fourmed and disposed, of such strength and complexion of body, that euery of them are proportionate of the Climate assigned vnto them, be it hote or colde, and may dwell and abide there, as in their naturall place and temperament, not lamenting, or desiring to dwell elsewhere, so great a loue resteth in them to their natiue situation. But not to depart from the vyage which the Sunne maketh in one whole yeere, as sometime approching neere vnto vs, and sometime departing from vs, I say, that at one selfe same time, in diuers partes vpon the round Globe of the earth, it causeth the Spring, Sommer, Autumne, and Winter. And neuertheless, at the same instant and punct of time, it maketh day and high noone in one place, and nyght and midnight on the opposite part. The which varietie, although it appeare incomprehensible to the slenderness of our wits, yet beholding the same with the eyes of vnderstanding, and therewith considering the vnestimable mooving that the Sunne maketh continually, we shall fynde it to be true, hauing respect to the diuers situations of the earth, as it is continually illuminate more or lesse by the Sunne. And this varietie is made with such a harmonie and consonancie, and such a lawe perpetuall and immutable, that yf any poynt or pricke thereof should fayle, it is to be doubted lest the Elements should be confounded together, and returne to their first *Chaos*.

And to haue sayd thus much of the wonderfull effects of the course of the Sunne, it may suffise for an example to prooue how necessary a thing it is, not onely for all Pilots and Sea men to haue the knowledge heereof, but also for all other such as shall attempt great and farre voyages in vn-

knowen

knowen lands, and ſtrange countreys, as did of late Maiſter *Ienkinſon*, a worthy Gentleman, ſet foorth by you, and mainteined at your charges, more like an Ambaſſadour ſent from any Prince or Emperour, then from a company of Merchant men. Wherein, what commendation you haue deſerued, to the increaſe of your perpetuall fame and honour, I referre it to that I haue ſayd before. And as touching Maiſter *Ienkinſon*, what trauayles, paynes, and dangers he hath ſuſteyned, and hardly eſcaped, and what diligence and arte he hath vſed in the ſearching of ſtrange countreys, and in the deſcription of thoſe his voyages, it were but in vayne for me to wryte much vnto you, vnto whome the ſame is better knowen then to me. And therefore to conclude, with rendering iuſt commendations both vnto you and him, I can ſay no more, but as *Plato* wryteth in his Booke *De Legibus*, *Decens eſt eos cives laudibus ornare, qui corporis vel animi viribus, res arduas præcláras que geſſerunt, & legibus libenter paruerunt*. That is to ſay, It is decent to commend thoſe Citizens, that by theyr induſtry of body and minde, haue done great affayres, and haue wyllyngly obeyed good lawes. And thus eftſoones deſiryng your Honors and Worſhips to accept in good part whatſoeuer I haue ſayd of good will and affection toward you and your proceedings, and with your ſhield of iuſtice and auctoritie, to defend me againſt the aſſaults of ſuch as are enimies to vertue, and captious of other mens doings, I reſt at your commaundement to the vttermoſt of my power, to do you what ſeruice I may.

(*.*)

(*)

The Epistle dedicatorie of Martin Cortes, to the most mightie and victorious Monarch CHARLES the Emperour, the fyfth of that name, King of Spayne.

SO greatly were esteemed the inuentours of certayne Artes and Sciences in auncient time (as wryteth Saint Augustine in his bookes De Ciuitate Dei) that they tooke them not for mortall men, but honoured them as immortall gods. Isis arriuing in Egypt, ordeyned common weales with iust gouernaunce, gaue them lawes, and knowledge of letters, and targht them also the vse of Flaxe. In consideration whereof, she was honoured of such as then knewe her, and reuerenced of them that came after her: In so much, that they established a capitall penaltie or punishment of death, against all such as eyther in sport or in earneste affyrmed her to be an earthly woman, and not rather a diuine Goddesse. Ceres beyng of lyuely wit and cleere vnderstanding, beholding in the Cicilians humane similitude and shape to the outward apparance, and inwardly the fiercenesse of brute beastes: brideled their customes, and reformed them with newe Statutes, teachyng them to tame Oxen to beare the yoke, to sowe Wheate for their great commoditie, to grinde in the Myll, to kneade in the horse, and to bake in the Ouen. In recompence whereof, they made sacrifice vnto her, and builded many sumptuous Temples in honour of her. Saturnus comming from Creta, gaue lawes vnto the Latines, whereby they might gouerne themselues, and prescribed them maners of lyuyng, teaching them to Tyll and Manure the ground, and sowe Corne, and to geather ripe fruites in due season. And if Saturne were profitable to those nations, and they not vnthankefull vnto him, in that they builded him aultars, celebrated vnto him festiuall dayes, and accompted him in the number of the heauenly Goddes, naming him also the father of the Gods. And (if I say) he was to them so profitable, and that world iudged so happy and prosperous for hauing

The fyrst inuentours of Artes.

Isis.

Ceres.

The Cicilians.

Saturne gaue Lawes to the Latines.

Tillage of the ground.

The golden worlde, and raigne of Saturne.

ning so valiaunt a King, and so iust a Lawe geuer, that it was therefore by the mouthes of all men called, The Golden World, and Raigne of Saturne: *Certes, except I greatly deceyue my selfe, this our time is nothyng inferiour to that. For We knowe certaynely, that your Maiestie hath beene more profitable to Spayne, then euer was* Saturne *to the* Latines: *and also a more excellent Lawe geuer, in manner to all* Europe, *and further, to the newe World, lately discouered, then he that gaue lawes but onely to a little corner of* Italie. *Whereby I consider, that the felicitie of your Maiesties time, hath been no little commendation to your dooings, in that you haue banished vice, honoured vertue, punished offendours, and fauoured innocentes: so that the quiet haue thereby lyued more peaceably, the vnquiet restrayned, the good exalted, and the euyll chastised: In so muche that nowe, by reason of iust ministration of good order in your Maiesties dominions, they that walke in the nyght, goe in safetie, whereas We knowe, that in other Prouinces, such as walke in the day goe in daunger and peryll. And therefore in the most happie tyme of your Maiestie, it appeareth that Spayne is renewed, not onely in the excellencie of Mechanicall or handy craftes, but also in the knowledge of letters, and discipline of warre: In so much, that she that sometyme lacked her selfe, may now abundantly minister to her neighbours that haue neede. And whereas to your imperiall Maiestie, it shoulde not suffice to ordeyne lawes, if power and armes shoulde fayle to defende and punyshe: Who, comparable to your Maiestie, enioyeth the one, and wanteth not the other, hauyng tryumphed ouer Kynges and Kyngdomes, enlarging also the name of Spayne in many vnknowen and barbarous Landes and Nations? Greater dueties therefore owe your Subiectes vnto you, then euer dyd the* Egyptians *to* Isis, *or the* Cicilians *to* Ceres, *or the* Latines *to* Saturne, *for as muche as they haue receyued of your Maiestie more common and profitable benefytes.*

Spayne reformed.

The triumphs and victories of Charles the fyfth.

It is not long since your Maiestie hath forbydden and abolyshed the vse of Mules, and restored agayne the exercise of Armes, so long out of vse, that the one with the other, hath been no small profite and commoditie to your Subiectes and Dominions. For by taking away the vse of Mules, is so encreased the

Mules.

number

number of Horsses and Horssemen, that suche as before neuer durst or coulde in manner lyght vppon a Horsse, cannowe easily and aptly manedge them. So that yousseme to haue reuiued the dayes of Bellerophon the sonne of Kyng Glaucus, and lykewyse the tyme of Saturne, when men had fyrst the knowledge howe to make Horsses to abyde the brydle, and to bryng them vp to serue for dyuers vses and necessities of men. And ryght sure I am, that by reason of suche laudable Statutes and Ordinaunces in your Dominions, shall fayle neyther Horsses nor Horssemen, as well for the Courte, as for the Campe. horses and horsemen. Bellerophon.

Who knewe in manner howe to girde a Swoorde, before that your Maiestie permitted Weapons and Armour to bee worne, euen in your Courte, and that else-where all men myght doo the lyke? before whiche tyme dexteritie fayled, where courage abounded. Ouer and besyde the profite and commoditie that hath ryssen heereof, what honour you haue obteyned by the same, is manifest by Frauncis the Frenche Kyng, who by your Maiestie beeyng taken prisoner in the Parke of Pauia, was brought to Madrid, in the yeere a thoussand fyue hundred twentie and fyue, where seeyng many young men in maner without beardes, and yet laden with Armour and Weapons, sayde, O happie Spayne, that bryngest foorth and nourysshest men of VVarre. In your most happie dayes also, the Christian Fayth is amplyfyed, and in manner whole Spayne florisheth dayly more and more in sumptuous buyldyngs, and is abundantly enryched in treasure brought from your Indies, farre surmounting the ryches of Solomon brought from Ophir. Yea, and to say the trueth, consydering the Nauies of Golde and Sylner, which haue been ordinarily brought from thence to your Maiestie, thys tyme may rather be called the golden age, then that of Saturne. Not omitting also, that by your prosperous attemptes, haue beene discouered so many Landes and Ilandes, heeretofore so vnknowen to the Cosmographers, Geographers, and Historiographers, that they neuer heard of theyr names. VVhiche neuertheless, are now so well knowen to your Subiectes, that they haue troden them with theyr feete, and measured them by paces. VVho before thys tyme euer heard any Wearing of weapons and armour. Frauncis the French king taken prisoner. The Christian faith enlarged. The sumptuous buyldings and riches of Spayne. The Indies nauies of golde and syluer. New landes and Ilandes discouered.

Peru.

ment on of the ryche and large Prouince of Peru, or of the straights of Magalianes, or of the ryuer of Syluer, called Rio de la Plata. They in times past seemed to haue doone no small thyng, when they had knowledge of the fortunate Ilandes, the which, since they were conquered by your Maiesties Graundfather, haue beene called the Ilandes of Canaria. And if it be, and hath been much to discouer and subdue this newe worlde: it is doubtlesse no lesse glory to your Maiestie, not onely to possesse and enioy it, but also that you dayly procure to send thither Iudges to gouerne with Lawes, and Preachers to instructe in Doctrine, to bryng those Indians to the knowledge and honouring of the true GOD. And therefore consyderyng your Maiesties godly desyre and purpose, as touching these Nauigations, and the daungers of such as goe to discouer this newe worlde (although it be not newe to the Spaniardes to trauayle into farre Countreys, for as much as in the dayes of Caius Cæsar, the sonne of Augustus, were founde broken peeces of Spanish Shyppes, lost in the Gulfe of Arabie, as also Celius Antipater affyrmeth, that certayne Shyppes of Spayne were accustomed to sayle for Merchaundize to the East partes of Ethiope) in consyderation heereof, haue I the more willingly published these my trauayles, for the furtherawnce of all suche as shall hereafter attempt the lyke Nauigation.

The straights of Magalianes.

Rio de la Plata.

The fortunate Ilande, or Canaries.

Religion in the Indies.

The Spaniardes haue euer trauailed into far countries.

And heere doo I not say that Naugation is not a thyng of antiquitie. For we reade that in olde tyme, the Argonanti sayled to Colchos, and Danaus brought the fyrst Shyppe from Egypt to Greece. But I saye, that I am the fyrste that haue brought the Arte of Nauigation into a briefe compendiousnesse, geuing infayleable principles, and euident demonstrations, describing the practise and speculation of the same, geuing also true rules to Mariners, and shewyng wayes to Pilottes, by teachyng them the making and vse of Instrumentes, to knowe and take the altitude of the Sunne, to knowe the Tydes or ebbyng and flowing of the Sea, how to order theyr Cardes and Compasses for Nauigations, geuing them instructions of the course of the Sunne, and motions of the Moone: teachyng them furthermore the making of Dyalles, both for the day and for the nyght, so certayne, that in all places they shall shewe the true houres without default:

The antiquitie of Nauigation.

Argonanti.

Colchos.

The Arte of Nauigation.

Things partayning to nauigation.

and

and haue likewise declared the secret propertie of the Lode stone, with the maner and cause of the Northeasting and Northwesting (commonly called the variation of the compasse) with also instruments thereunto belonging. And that, that which I shall say or doo, be not accompted to be presumpteously done or spoken, I acknowledge that whatsoeuer I haue well done or written, it is from aboue by the helpe of the diuine grace, and by the fauour and prosperous fortune of your Maiestie. And thus shall they that now liue, and likewise they that shall succeede vs, see and perceiue, how much more the world oweth and is beholding to your Maiestie, then were the auncient Egyptians to their Isis. She gaue them letters to reade, but your Maiestie hath geuen rules and orders to sayle on the Seas. The profite of Isis was onely for one Prouince. But the commoditie that ensueth of your doings, is vniuersall for all Prouinces and Nations, and for all Seas, aswell to go to places discouered, as also to discouer Lands and Regions yet vnknowen. If they of auncient time had reached that we haue obteyned, the Indies had not now been to discouer: neyther should it be esteemed a miracle vnto vs, as at the tyme when Carthage florished, that one Agnus went foorth from the Baye of Cadiz, and sayled to the end of Arabie. Neyther would Cornelius Nepos haue written it for so famous a thing, that a certayne man flying from King Latinus, came from the gulfe of Arabie: Whereby it is manifest, that aswell Nauigation, as other Artes, doth from day to day increase, and by litle and litle is come to perfection. For in those dates they had neyther compasse nor carde of sayling whereby to gouerne them selues. They lacked the consideration of the Starres, vntil the Phenitians found the knowledge thereof, and were the fyrst that vnderstoode (that to such as should trauayle by sea) it should be necessarie to lift vp their eyes to heauen, and consider the motion thereof. They that sayled to the Iland of Tabrobana, (which in old time was called Antitono) caryed for their voyages tyming fyrds. And when they thought good, let certayne of them flee: and by the flyght of their wings, directed the helme and sayles of their Ships. They sayled onely three monethes in the yeere. To them therefore it was necessarie to obserue and know the tyme, vntil they found it to serue with a forewynde. They knewe not how to helpe

The lodestone falsly called in English Adamant, is in Latine called *Magnes.*

Charles the 5. greater then the heroes of olde tyme.

Vniuersall benefites.

Comparison with the antiquet.

Plinie.

Nauigations of olde time.

The perfection of artes at this day.

The rudenesse of the antiquite.

Augurium.

The North Starre.

The voyage of Solomon to Tharsis and Ophir.

themselues with the bowe lyne, or syde winde: neyther sawe they the North Starre, or sought it, or had any knowledge thereof. And I beleeue veryly that this was the cause of so long a voyage which the Shyppes of Solomon made, saylyng to Tharsis and Ophir, wherein they spent three yeeres: although in deede that was no short voyage which they made, compassyng about India, and many other Prouinces. And whereas before I sayd, that Nauigation by litle and litle came to perfection, I fynd by auncient hystories, that Tipho fyrst found the Gouernale or Rudder, Dedalus the Maste and Shrowdes, and Icarus the Sayles, the Thirreni found the vse of the Anker of one graspe or flooke, and Palaminus brought it to perfection, adding the other. And thus may it manifestly appeare, that in these prosperous and fortunate dayes of your Maiestie, it hath pleased God to bring the knowledge of Nauigation to perfection, with this my breefe discourse as touching the same, aswell profitable and necessarie for them that trauayle by land, as by Sea. What can be a better or more charitable deede, then to bring them into the way that wander? What can be more difficult, then to guide a shyp engoulfed, where only water and heauen may be seene? One of the foure most difficult things, whereof Solomon maketh mention in his Prouerbes, is the voyage of a Shyp by the Sea. The which Galfrede expounding, sayth, that in humane things, none is more fearefull or more daungerous, then to aduenture life in a thinne and weake peece of wood, or for a man to commit himselfe to the rage of furious windes, among the tempestes of the Sea, and there to hazard that he loueth so well. O how much more should the same seeme difficult to Solomon, if at these dayes he should see that fewe or none of the Pilottes can scarsely reade, and are scarsely of capacitie to learne? And whereas in the fyrst Chapter of this Booke, I haue made mention, that the gouernall or sterage ought to be committed to expert men, and of good vnderstanding, he should see, that now adayes, the ignorant presume to gouerne other, which were neuer able to rule or gouerne themselues. I most humbly desire your Maiestie, to receiue in good part this my poore seruice, which, although it be litle, yet being dedicate vnto the greatnesse of your regall person, it shall be much more then great. The profite and commoditie thereof, is notorious, and the benefite

The first inuentours of nauigation.

Commodities & difficulties of nauigation.

The ignorance of Pilotes.

The gouernal.

that thereby may be receyued, is vniuerſall. If therefore, when your Maieſtie ſhall finde your ſelfe releaſed from greater affaires, it may pleaſe you to feede your eyes with theſe my trauailes, you ſhall fynde therein many new, delectable, and witty things, with alſo many profitable and certayne rules, both to reade and vnderſtand. To conclude, I eſteſoones make humble petitions to your Emperiall Maieſtie, not ſo much to conſider what I wryte, as to reſpect the intent of my wrytyng: and not the gift, but the affection and good will that remayneth in mee to ſerue your Maieſtie.

The firſte parte of this woorke,

which entreateth of the compoſition of the world, and of the vniuerſall principles for the Arte of Nauigation.

¶ The fyrſt Chapter, of the generall diſtinction of Creatures.

THE infinite GOD, the begiming, and cauſe of the whole vniuerſall world, created thꝛee oꝛders of creatures, differing in kinde: that is to ſay, Coꝛporall, as the Elements, Spirituall, as Angelles, and coꝛmpounded of theſe two, as Man. The coꝛporall nature is diuided into bright and ſhining bodyes, as the Starres: oꝛ into darke and thicke bodyes, as Earth and Metalles: either into Diaphane oꝛ tranſparent bodyes, as Ayre and Water. Of theſe creatures (as ſayth Saint Gregoꝛie) ſome haue onely being, as Stones, ſome lyue, as Trees, and other haue ſenſe, as Beaſtes, other vnderſtanding, as Man, who in holy Scripture is called all Creatures, accoꝛding to the ſayi ng of Chriſt to his Diſciples, where he ſayth, Goe and preache the Goſpell to all Creatures. And theꝛefoꝛe not without good cauſe was Man called of the Greeke Philoſophers, *Microcoſmos*, (that is) the leſſe World. In the which we contemplate thyngs of no leſſe admiration, then in the great World. The ſimilitude betweene them both, is, that euen as the great woꝛld, and the whole Globe oꝛ Sphere theꝛeof, is mooued by the voluntarie motion of an intellectiue ſubſtaunce, oꝛ an Angell: euen ſo is this. Foꝛ (as Ariſtotle wyteth) What ſo euer is mooued, is mooued by vertue of an other: As, Man is mooued by the internall oꝛ inward fourme that is within him (that is to ſay) by the intellectiue ſoule that is pꝛoper vnto him. In lyke maner, in the great woꝛlde are found dyuers mooueable thyngs: All which, are reduced to one immoueable mooter. So in man are found many thyngs mooued by diuers motions, which are all referred to his intellectiue

Three differences of creatures.

Corporall creatures.

Man is called all creatures, and the leſſe world.

Man compared to the world.

All that mooueth, is mooued by an other immoueable.

The intellectiue ſoule.

tiue soule. The great worlde conteyneth the creatures within it selfe, and consequently is all really, as hauing nothing without it. Euen so, man by knowledge is all, and knoweth all things, and nothing naturally is hid from him, or vnknowen to him. Agayne, in this lesse humane world, are two motions, Intellectiue, and Sensuall. Then consequently the great world hath two locall motions: the one, wherewith the fyrst mooueable is mooued, and draweth with it all the other Spheres from the East to the West, and is called Rationall mooung. The second, is the mooung of the other Spheres, from the Weast into the East: and is called Irrationall mooung. But now leauing to speake of the lesse world, we will proceede to speake further of the great.

Man knoweth part of all things.

Two motions in man.

Primum mobile.

Rationall motion.

Irrationall motion.

¶ The seconde Chapter, of the definition of the worlde.

THE world (as sayth Isodorus) is Heauen and Earth, and the other woorks of God that are conteyned therein. It is compounded of things visible, and yet vnsearchable. Moses and Saint John the Euangelist witnesse, that it was made by God. The Philosophers called it *Mundus a mouendo*, because it is in continuall mooung, and neuer in rest. The Greekes called it Cosmos, which signifieth, Fayre, or Beautifull, and so named it, because of the marueilous ornament thereof, and diuersitie of Elements, with the resplendence or shining of the Sunne, Moone, and Starres. And doubtlesse, nothing may be seene with the corporall eyes of man, more beautifull then it is. In so much that the diuine Philosopher Plato affyrmed, that eyes were geuen to men to beholde the beautie thereof, and to take pleasure in the contemplation of the heauenly bodyes, and roundnesse of the world, which also for the roundnesse thereof, is called Sphericall, because that Sphera in the Greeke tongue signifieth a round body.

What is the world.

Or Mundus a Munditia.

That is, clearnesse, or fairenesse.

Eyes were geuen to men to behold the fairenesse and beautie of the world.

The roundnes of the world.

The

The thyrd Chapter, of the definition of the Sphere.

Definition of the Sphere.

THeodosius sayth, that the Sphere is a whole and corporall figure, vnder one superficial: in the middest whereof, is a poynt or pricke, from the which all right lines drawne directly to the circumference, are equall.

The center of the Sphere.

This poynt or pricke, is called the center of the Sphere: according to Euclide, it is the passage of the circumference of halfe a circle, which is turned round about his Diameter that is fixed, vntill it returne to his owne proper place againe, as where it was at the fyrst. By the center of the Sphere, passeth a right lyne, and the extremities or endes thereof, touch in the circumference. And this lyne (imagined) is called the Axis, or Erth tree of the Sphere, and the endes thereof are called the Poles. Vppon this Axis is the Sphere of the world mooued.

The axis and Poles of the world.

The fourth Chapter, of the diuision of the world.

Quinta Essentia.

Aristotle calleth it the fift element.

The fift essence is incorruptible.

What is element.

The inferiour elements are not pure nor simple.

IT is to be presupposed, that there is a difference betweene Element, and Elementate, and the fyfte, being called *Quinta Essentia*. The Quint essence, or fyfte substance, is a body of it selfe, differing from all Elements, and thinges Elemental, aswell in matter as in fourme, and no lesse in nature and vertue: and hauing in it selfe no contrarietie, is certaynly without corruption. And hereof commeth it, that the Philosophers called the heauens and heauenly bodyes, the fyfth substaunce, or fyfth essence, by reason of the incorruptibilitie thereof. Element is that, whereof any thing is compounded. It is the fyrst of compositions, and of it selfe is not compounded. Whereby it followeth, that neyther the earth, the ayre, the water, nor the fyre, that are neare vnto vs, or about vs,

ds, are pure and simple Elements. For these Elements do sometimes mingle themselues one with another, and especially where they are neare togeather, and touche one another. Of these elements euery part is named by the name of the whole: As euery part of fyre, is called fyre, and euery part of earth, is called earth, and so of the other. They are called simple bodyes in respecte of other compound and mixt bodyes. They are diuisible into partes of diuers fourmes: and of the commixtion of them, are made and engendred diuers things of sundry kyndes. These foure (that is to meane, Earth, Ayre, Water, and Fyre) although they are named simple, but in respecte as afore sayde, yet are they the Elements (that is to say) beginnings and principles of all other compoundes and mixtes. A pure Element can not be seene, forasmuch as that that is pure, lacketh colour: and that that hath no colour, is not visible. The Elements (as sayth Isodorus) were diuided by the hand of God. The imperiall Heauen was replenished with Angelles, the ayre with byrdes, the sea with fyshes, and the land with men, and other beastes. Elementate, is euery body compounded of the foure Elements. Not that they are Elements formally, but vertually in mixt bodies. This knowen, we will shewe how the world is diuided into two regions: Celestiall, and Elementall. The region Elementall, which is continually subiect to alterations, is diuided into foure Elements: which are, Earth, Water, Ayre, and Fyre. These Elements, the Greekes call Ydogia, for the communion and concord that they haue betweene themselues. The heauenly or etheriall region (called *Quinta Essentia*) compasseth and conteineth the Elementall worlde within it.

The elements are diuisible into partes.

The commixtion of elements.

Pure & simple elements can not be seene.

The diuision of elements.

What is elementate.

The Ocean sea.

Diuision of the world into Celestiall and elementall.

Quinta Essentia

The

The fyfth Chapter, of the number, order, and propertie of the Elements and Heauens.

The order of Elements.

THE Earth (after the Philoſopher) is a pricke or poynt in the middeſt, called the center, to the which they aſſigne the loweſt place. Next vnto the earth, and about it, the Water occupyeth the ſecond place, and the Ayre the thyrd. The Fyre is higher then any of the other elements. And it is to vnderſtand, that the water hath two ſuperficials. One, which is called concaue, or holowe: the other, conuex or embowing. You may compare the inward part of the concaue to a dyſhe or a bolle, whoſe outward part is called conuex. As touching the concaue, the water compaſſeth about the earth, leauing diſcouered that part that ſerueth for the reſpiration and life of men, and other beaſtes.

Earth.
VVater.
Ayre.
Fyre.

The fourme of the water.

The Ocean Sea.

As concerning which, ſome thinke that the Ocean Sea is higher then the earth: and aſke the queſtion why the Sea couereth not the whole earth, and why the earth is not ſunke in the water? To this it may be a ſufficient anſweare, that it hath ſo pleaſed the wyll of God, according to the ſaying of the prophet Dauid: *Terminum poſuiſti quem non tranſgredientur, neque conuertentur operire terram.* That is, Thou haſt appoynted limits, which it ſhall not paſſe, neyther ſhall it returne to couer the earth. Beſyde the wyll of God, which is the cheefe and ſufficient cauſe thereof, we ſay that nature fayleth not in her neceſſaries. For ſhe ſometime admitteth a litle inconuenience, to auoyde a greater euill: as when heauie thinges, which naturally ſhould deſcend, doo not only not deſcende, but riſe vp: And as alſo ſometime it chaunceth that fyre deſcendeth, and water aryſeth to fyll the voyd or emptie places, leaſt any where ſhould be found voyd or emptie, which nature ſo greatly abhorreth. To this purpoſe, nature foreſeeing the kindes of many thinges that could not elſewhere liue then on the earth, neither bee conſerued within the water (as men, and other earthly beaſts) determined before to make the earth not perfectly round, contrary to the nature thereof: whereof it followeth, that it is not altogether

Pſal. 103. *Iob.* 38.

The will of God, is the cauſe of cauſes.

Nature abhorreth emptines.

The earth is not perfectly rounde.

ther couered of the water. And as (sayth Origen) the earth remayneth discouered of water, that it might bring forth fruites, trees, and plantes. As touching the conuex aforesayde, the water and earth discouered, are conteyned vnder the concauitie of the ayre, which is diuided into three Regions, as the lowest, hyghest, and middlemost. The lowest is hote, by reason of the reflection or rebounding of the beames of the Sunne, stryken backe by the earth. The highest also is hote, by participation of the fyre, and nearenesse thereunto. The myddle region is colde, as is manifest by the snowe and hayle, engendred in the same. The ayre neare vnto the region of the fyre, which is pure heate, doth neither burne nor lighten, because it hath no combustible matter, and so hath it power, and not acte. It is neare vnto, and reacheth the circle of the Moone, which compasseth it about. The heauen, or circle of the Moone, is next vnto the heauen of Mercuri: and Mercuri vnto Venus: Venus, vnto the Sunne: the Sunne, to Mars: Mars, to Iupiter: Iupiter, to Saturne, which is next, and reacheth vnto the heauen of the Starres, called the Firmament, because that in it are all the Starres (except the Planets) firme and fyxt as a knot in a table. The knowledge of the Planets was had by seuen sundry motions they haue among themselues, and by their course, not vniforme to that of the Starres of the eyght heauen, because that sometimes the Planets appeare vnto vs ioyned togeather, and sometimes diuided. The Christaline heauen, compasseth about, or conteyneth within it the heauen of Starres. This Christaline heauen, is transparent, and perspicuous, as cleare water or glasse that may be seene through, by reason of the cleerenesse and pure substaunce thereof. It is by an other name called, the heauen of water, whereof holy Scripture speaketh, saying, *Aquæ quæ supra cælos sunt, laudent nomen Domini.* That is to say, Let the waters that are aboue the heauens, prayse the name of the Lord. It was created for the conseruation of corporall things, and to temper the heate engendred of the mooning of the fyrst moueable, which being so great of body, that it not onely compasseth all the Elements, but also all the inferior heauens is mooued so swiftly, that it dayly perfectly mooueth all the aforesaid Spheres. And least by reason of the great heate thereof, caused by

Diuision of the ayre into three Regions.

The hyghest ayre is incombustible.

The order of the heauens.

The Firmament.

The Planets.

The Christaline heauen.

The heauen of water. *Psal.* 148. *Daniel.* 3.

The mooning of the first moueable.

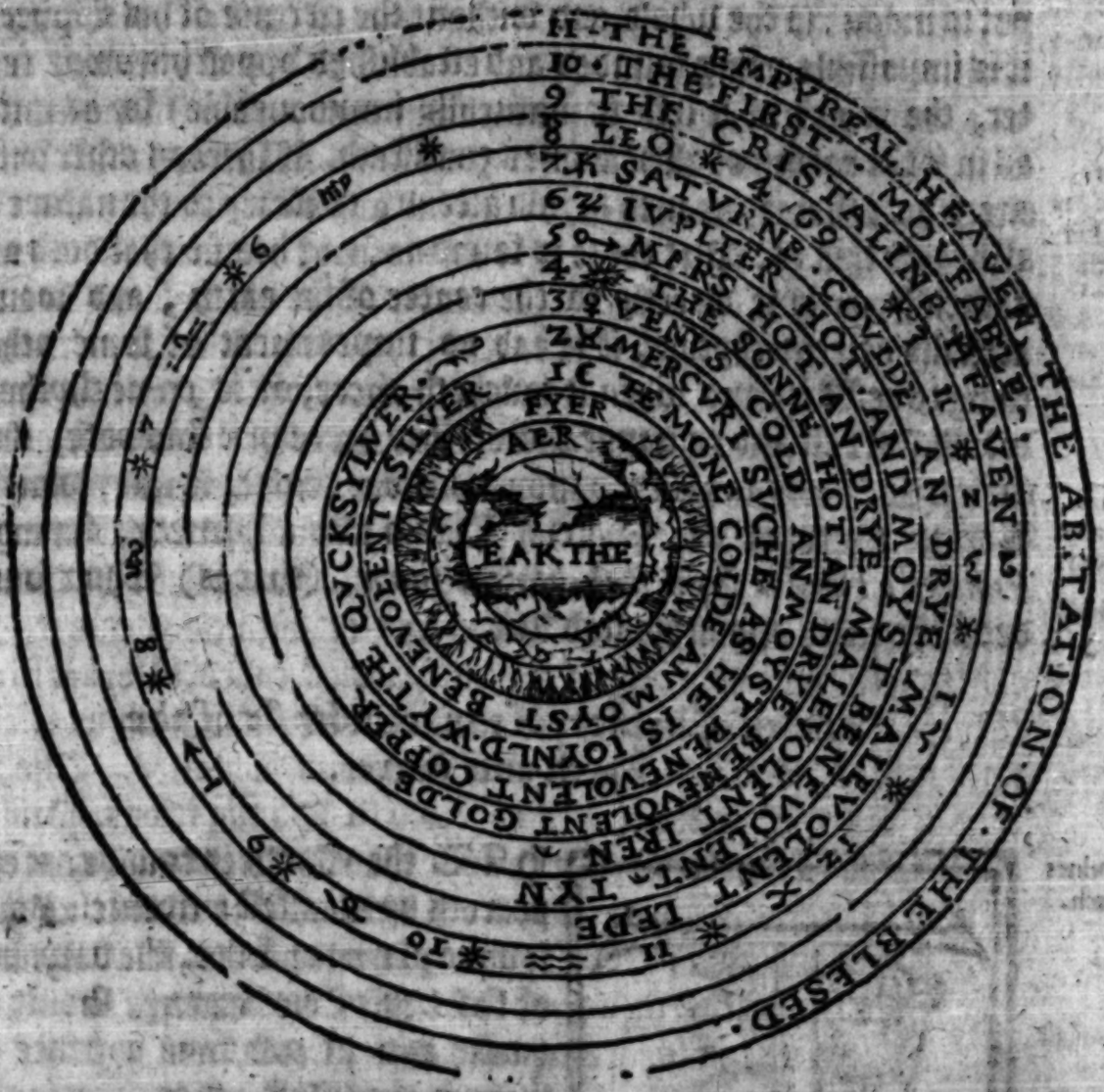
The coldnesse of the Christaline heauen. The heauen of the fyrst moueable.

by his swyft motion, it should consume inferior things, God ordeyned this Christaline heauen, that the coldnesse thereof might temper the extreame heate of the other. This Christaline heauen, reacheth vnto the first moueable heauen, called Primum mobile. And this reacheth to the Empyriall heauen, which is the twelfth, called Empyrium, by reason of his cleerenesse and resplendence. This is not moued, and is most perfect. The Philosophers had no knowledge hereof. But we beleeue by holy Scripture, that such a heauen there is, and the same to be the habitation of Angelles, and Spirituall creatures. It is also called Cœlum Cœlorum, that is, The heauen of heauens: because it conteyneth and includeth within it all the other heauens. It is of greater cleerenesse then all the other heauens, and was created immediatly with the Angelles. In this also remayneth the humanitie of Iesus Christ our GOD, and in dignitie aboue it. It conteyneth three holy orders or principalities, called, Hierarchias. Whereof the fyrst is called Supercelestiall, and hath in it also three orders, Seraphims, Cherubims, and Thrones. The second is called Celestiall, and conteyneth Dominations, Principates, and Potestates. The third, called Subcelestiall, conteineth Virtutes, Archangells, and Angelles. And to conclude, it hath abundance of all goodnesse and perfect felicitie, with priuation or want of all euill. The heauen also geueth influence of constancie, stedfastnesse, and durabilitie to things, against the flurrabilitie and inconstancie of the other heauens: the order whereof, doth appeare in the demonstration following.

The humanitie of Christ in the Empyriall heauen. Three orders of angelles.

The Empyriall heauen preferreth all the other heauens.

(c.)



The vi. Chapter, of the immutabilitie or immobilitie of the Earth.

THE Pythagorians, and other auncient naturall Philosophers (as sayth Aristotle) were of opinion that the earth did moove, yet not by a rycht footh motion, but circulerly about the middest of one place. The which errour, both Aristotle himselfe, and the Astronomers doo confute and repoove by euident causes, and manifest demonstrations: For circuler motion, is proper to the heauens. And as the earth differeth from them in nature, so likewise in mooving. And although it be so

Opinion that the earth mooueth.

Motus in loco.

The earth is immooueable.

ſo that the earth may naturally moone by certayne of his partes, yet to moone in the whole, and without the circuite of his Sphere, it is impoſſible, being founded and eſtabliſhed vppon his owne center, the which of it ſelfe is naturally immooueable: for as much as in it the reaſon of all heauynes conſiſteth. Whereas otherwiſe, euery part that is mooued ſhould aſcend, contrary to the nature of all heauie thinges. But there is found nothing heauie that doth not naturally enclyne directly to the center of the earth, and would actually deſcend thyther, if it had no impediment of ſome other thing to reſiſt it: and when it toucheth there, or is come thyther, would ſtill reſt and remayne there. And heereby it foloweth, that the earth, being founded vppon his owne center, is not mooued. The which thing the Prophet Dauid alſo affyrmeth, ſaying: *Fundaſti terram ſuper ſtabilitatem ſuam*, (that is) Thou foundedſt the earth vppon his ſtabilitie.

All heauie things enclyn to the center of the earth.

The earth is founded vppon his owne center.

Pſal. 130.

The vij. Chapter, of the roundneſſe of the Earth and Water.

The roundnes of the earth.

The ryſing of the Sunne.

The Eclipſe of the Moone.

THAT the Earth is rounde, it appeareth by manifeſt euidence: For if it were playne or flatte, the dawning of the day or day ſpryng, ſhould equally and at one time appeare to them in the Weſt, as to them in the Eaſt. But we ſee the contrarie, that it appeareth fyrſt to them that dwell in the Eaſt, and afterward to them in the Weſt. This is prooued by the Eclipſe of the Moone, which beginning at one inſtant, they of Hieruſalem ſee it begin at foure a clocke of the night, and we of Andaluſie in Spayne, at one a clocke of the night. It foloweth hereby, that to them it nighteneth three houres ſooner then vnto vs in Spayne: and this is cauſed by the roundneſſe of the earth.

It is alſo as well knowen to be rounde, from the pole Artyke, to the pole Antartyke: for by the roundneſſe thereof, is

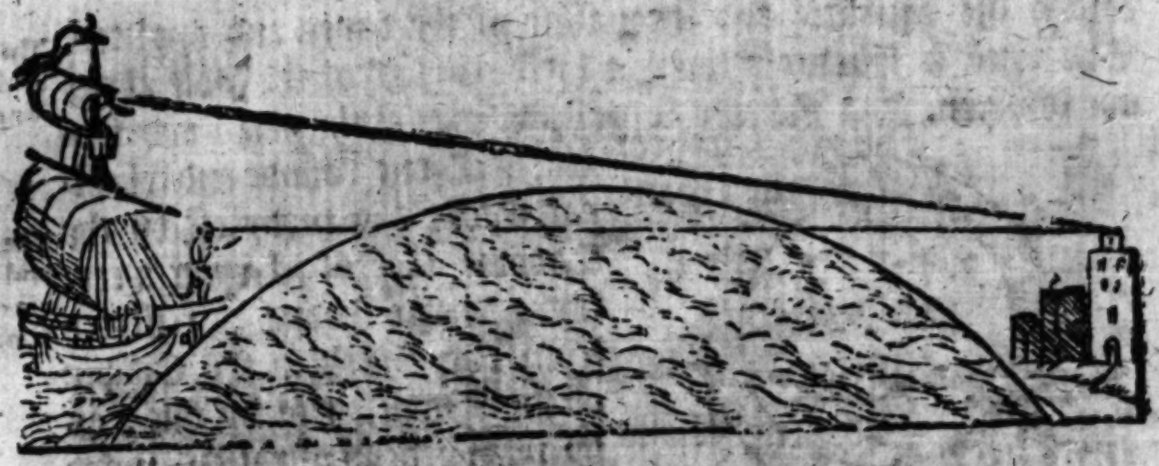
cauſed

causeth the equalitie and inequalitie of the dayes and nyghtes. The same is lykewyse knowen by the rayſing of the Pole aboue our Horizon. And that the ſuperficiall part of the earth and water, is all one rounde and ſpherical Globe, is manyfeſt by the ſhadowe thereof, beyng a certayne darke bodye, reflected from the Earth in the Eclipſe of the Moone. For by this, as by playne demonſtration, maye we knowe that the Earth is rounde, as may more manyfeſtly appeare by thys Figure. It is alſo moued, that the water is a rounde body, as is ſeene by experience. For yf you ereate a marke vppon the Sea banke of a Porte, and a Shyppe departe from that Porte a certayne ſpace: then ſtandyng in the Poupe or Sterne of the Shyppe, you ſhall not ſée the marke aforeſayde: but yf you ſtande in the top of the Shyp, then may you ſée it. Whereas notwithſtandyng (yf that portion of the bendyng Arke of the earth, dyd not hynder the ſyght) you ſhoulde ſée it better beyng in the Poupe, foraſmuch as it is nearer to the marke then to the toppe of the Shyppe, as by thys demonſtration folowing appeareth.

The equalitie of the dayes and nyghtes.

The earth and the water are one rounde Globe.

The water is a rounde body



But heere ſome may moue a doubte, ſaying, that on the earth we may ſee many Mountaynes, and conſequently many greeat Vallyes and Playnes, with many diuerſities of ſundrye other deepe and vnequall places, by reaſon whereof, the earth can not truely be called rounde. To this I ſay, that in two maners, the earth is called and vnderſtoode to be rounde. As after one manner, ſpeakyng preciſely, it is called rounde, as a Circle or a Sphere, which we call rounde, becauſe that all ryght lines drawen from the center thereof to the circumference, are equall. The other roundneſſe, is conſydered without this preciſeneſſe: and is ſuche, as not by all his partes is equally diſtant from his myddeſt or center, but hath ſome partes hygher, and ſome lower, yet not in ſuch quantitie as may deſtroy the roundneſſe of the whole. As yf in a Bowle there were certayne clyftes or holes, it ſhould not thereby leaue to be rounde, although not perfectly or preciſely rounde. And for this cauſe ſayth Auerrois, that although both the heauenly bodyes and the Elements are of round fourme, yet differ they in this, that the heauenly Spheres haue perfect roundneſſe, and the Elements not. As the earth, by reaſon of his Mountaynes and Vales, the Sea by his encreaſing, and decreaſing, the Ayre alſo for his nearenelle to the fyre, and by his contrarietie doth ſometime doo, and ſometime ſuffer (that is to ſay) is ſometime actiue, and ſometyme paſſiue. So that folowing the one, it fleeth the other, by reaſon whereof, it alſo lacketh perfect roundneſſe. But the fyre, for as muche as it is neare to the concaue of the circle of the Moone, which is Spherical, may therefore be called Spherical or rounde.

how the earth is round.

The ayre is actiue and paſsiue, and not perfectly round.

The fyre is rounde.

The viij. Chapter, of the motion of the Heauens and Elementes.

IT is not to be forgotten, that all the Elementes are wholy moueable by locall motion, except the earth. The water is mooued by the motion of the Moone, or tossed by the Wyndes. The fyre (as sayth Aristotle) is mooued circulerly by the motion of the day, and is drawen of the circles that embrace it, or compasse it about: as is manyfest by the Cometes, or blazing Starres, and other fyerie exhalations, conteyned and engendred in it: Which beeyng caryed with thys motion, conclude, that the fyre mooueth in lyke maner. And with thys motion is the superiour parte of the ayre violently caryed about, as the other impressions therein doo shewe. The inferiour part is mooued by dyuers motions, (that is to meane) laterally, as by experience we see when the wyndes blowe. The Moone with her Heauen or Sphere, by her proper motion geueth her turne from the West to the East, in xxvii. dayes, and viii. houres, with xv. minutes. Venus, Mercuri, and the Sunne, in a yeere, which is the space of three hundred threescore and fyue dayes, with fyue houres, and fourtie and niene minutes. Mars in two yeeres. Iupiter in twelue yeeres. Saturne in xxx. yeeres. The eyght heauen, which is the Fyrmament, or Starrie Heauen, by his owne proper motion is mooued by the nienth Heauen, vpon the beginning of Aries and Libra, and vpon these two poyntes accomplysheth hys Reuolution in seuen thousand yeeres.

how the fyre is mooued.

how the ayre is mooued.

The Moone.

Venus.
Mercuri.
The Sunne.
Mars.

The Starrie heauen or fyrmament.

This motion is called Motus trepidationis (that is to say)

The Christalline heauen.

the tremblyng motion, or motion of accesse and recesse. The nienth heauen endeth his motion from the West to the East, in fourtie and niene thousand yeres: And by this motion moueth the eight heauen. The tenth heauen, called Primum mobile, is moued from the East to the West: and in twentie and foure houres (whiche is a naturall day) perfourmeth one reuolution, and with the myghtye force and swyftnesse of his motion, caryeth wyth hym all the other inferior heauens, and maketh them to geue the same turne in twentie and foure houres, where as neuertheless they cease not in the meane tyme to kepe the course of theyr owne proper motion. As (for example) yf an Ant or Pismire should goe about the wheele of a Mylle, contrary to the moouing of the wheele: before the Ant in goyng styll forward, should come agayne to the poynt from whence she fyrst departed (which is once about, or one turne) the wheele should in that space make many turnes.

First moueable.

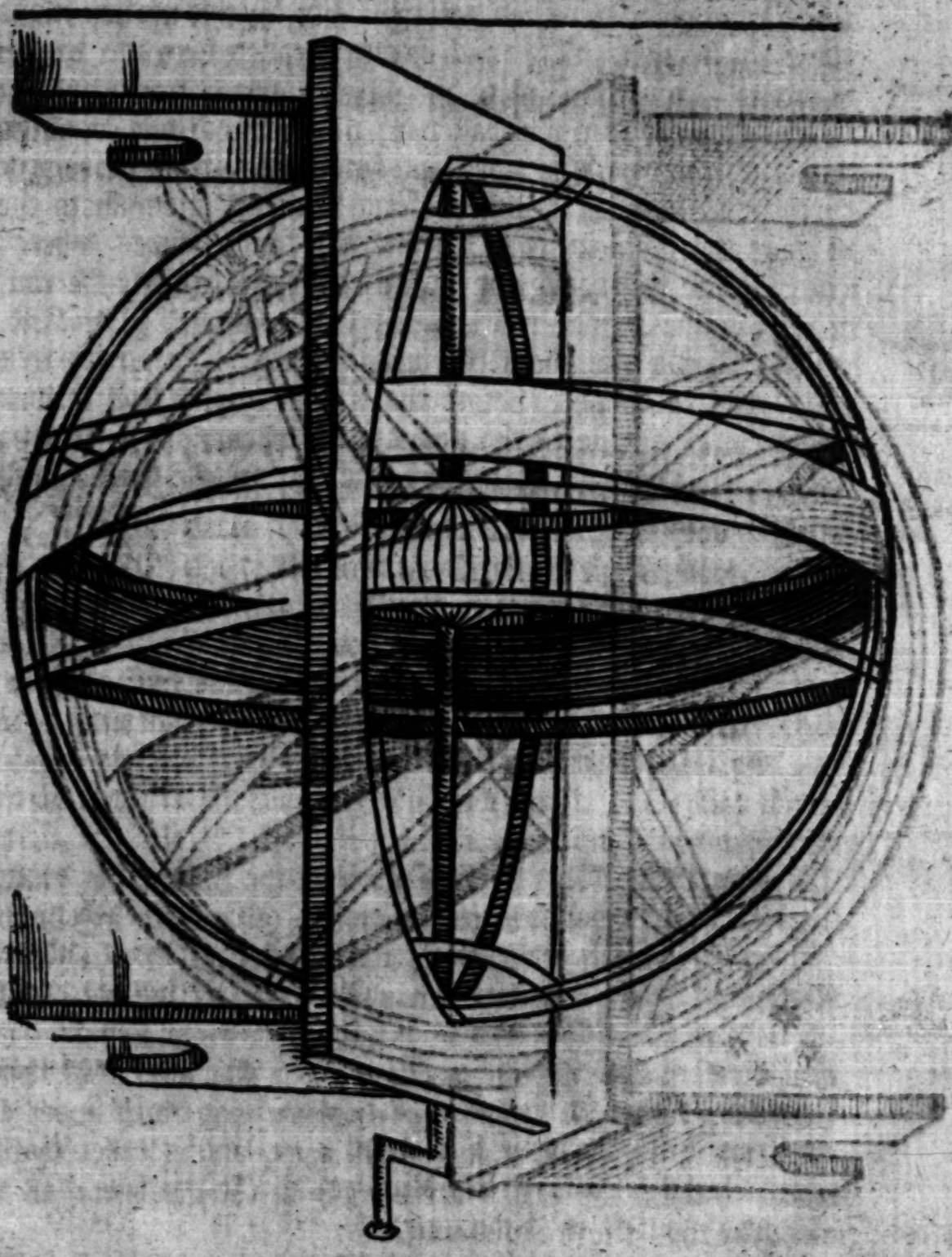
how the first moueable draweth the other heauens.

The ix. Chapter, of the diuision of the Sphere into formall partes.

THe Sphere of the worlde, is diuided in two manners, (that is to say) by substaunce, and by accident. By substaunce into tenne Spheres, as we haue sayde. By accident, into a right Sphere, and oblique or crooked Sphere. They haue the ryght Sphere that dwell vnder the Equinoctiall lyne, and is called ryght, because to them the Poles are equally in the Horizon, as appeareth by thys Figure folowing.

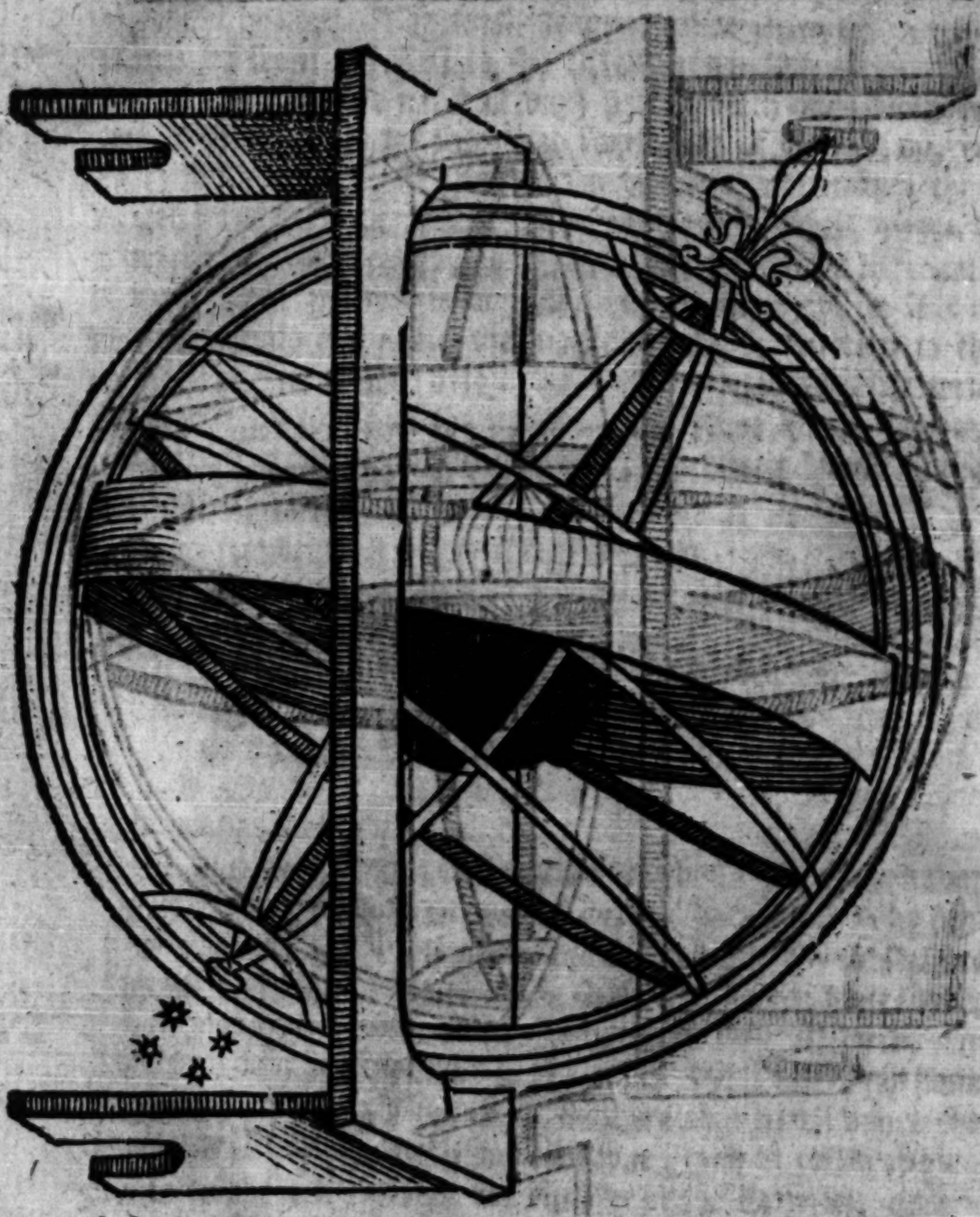
The right and crooked or oblique Sphere.

The



They haue the oblique Sphere that diuell eyther on thys syde by the other syde of the Equinoctiall, vnto whose is euer one of The oblique or crooked Sphere.

the Poles aboue the Horizon, and the other vnder it, as appeareth in this Figure.



How many circles of the Sphere.

The Sphere is compounded of tenne circles imagined, And (as sayth Iohn de ſacro boſco in his booke of the Sphere) fyre

of them are greater, and foure lesse, The greater Circle, is that which deuideth the Sphere into two equall partes, and hath his center with the center of it. These are the Equinoctiall, the Zodiacke, the two Coluri, the Horizon, and the Meridian. The lesse Circle, is that that deuideth the Sphere into two vnequall partes.

These are the two Troppykes, and two Poler Circles.

The x. Chapter, of the Equinoctiall Circle.

THE Equinoctiall, is a Circle that deuideth the Sphere into two equall partes, and is by euery parte equally distaunt from both the Poles. It is one of the greater Circles in the Sphere, and is the greatest Circle of those which are described in the Sphere, by the motion of Primum mobile, or fyrst moueable. This Circle, for his equalitie, and regularitie, is more noble then the Zodiacke, which we haue described in the eight sphere, and also then any of the other. It is imagined to gyrd the worlde round about by East and West. It is called Equinoctiall, because this word Equinoctium, signifyeth equalitie of nyghtes and dayes, whereof the cause is, that the Sunne comming to this Circle, the Arke of the day is equall with the Arke of the night, and then is the Equinoctiall. It is also called the Zone, or gyrdle of the fyrst moueable. For euen as a gyrdle doth gyrde a man by the myddest, so doth this Circle gyrd in the middest betweene both the Poles, vppon the whiche the fyrst moueable is mooued. One of these imagined on our parte of the Sphere, is called Polus Arcticus, because it is neare vnto certayne Starres, whiche the Astronomers call Arcturus, whiche is the great Beare. It is called Septentrional, or Septentrion, because that rounde about it are mooued the vij. Starres, whiche make the lesse Beare, commonly called Bozina, (that is, the

The Equinoctiall.

The equalitie of the day and nyght.

The fyrst moueable.

The Pole Artyke.

The horne. North Starre.

home. The Starre whiche is in the tayle of the lesser Beare, is called the Nyth Starre, becaule it is nearest vnto the Nyth Pole: the whiche Pole is a certayne poynt in the Firmament, which can not be seene, although the nyght be neuer so cleere. This Starre (as the Poet Homer sayth) dooth moone lytle or nothyng, because of his lytle distance from the Pole. The other Pole is imagined on the other contrary part, and is called Polus Antarticus, of the woord Ante, whyche signifyeth agaynste, contrary, or oppolite, because it is on the contrary parte from the Pole Artyke. It is also called the South Pole, because that from that parte of heauen commeth the Winde, commonly called the South: and is lykewyse called Meridional, because it is ryght South from vs. This is neuer seene to vs. They that dwell vnder the Equinoctiall, or come neare vnto this Pole Antartike, haue for a signe or marke to knowe it, foure Starres, in fourme of a Crolle. And when the greatest of these is lowest in the foote of the Crolle, they say it is xxv. degrees aboue the Pole. And as we can not see theyr Pole from hence, so they can not see our Pole from thence.

Pole Antarike.

The crolle neere vnto the Pole Antartike.

The xi. Chapter, of the Zodiacke Circle.

Zodiack.

THe Zodiacke is defyned to declyne or bende it selfe from the Equinoctiall. It is a greate Circle, whiche deuideth the Sphere in two equall partes, cuttyng the Equinoctiall by oblique or crooked angles: So that being thus cut or deuided by it into two equall partes, one parte thereof declineth toward the South, and the other toward the Nyth. This Circle is called the Zodiacke, of this woorde Zon, which in the Greeke tongue signifyeth lyfe, becaule that accordyng to the mouing of the Planets vnder it, is the lyfe of inferiour creatures: Or is so named of Zodion, whiche signifieth a lyuyng beast. And is therefore diuided into twelue

The twelue signes of the zodiacke.

twelue equall partes, whereof euery part is called a signe, and euery signe hath an especiall name of some beast, in respect of some propertie agreeable to the same: or for the order and disposition of the fixt Starres in those partes, somewhat representing the similitudes of suche beastes, it is called Zodiacke.

The Latines called this Circle, Signifer, (that is) the signe bearer, because it caryeth these signes or images in it also, because the twelue partes, into the which this Circle is deuided, are called the xij. Signes. That parte which declyneth to the North, conteyneth vi. Signes septentrionall, and the other that declyneth to the South, conteyneth other vi. called Meridionall. Furthermore, it is to consyder, that the zodiacke may be deuided in two maners. One, by longitude or length into the xii. signes aforesayd, and euery signe is deuided into xxx. degrees, which make CCClx. degrees, lykewise, euery degree is deuided into lx. minutes, and euery minute into lx. secondes, and euery seconde into lx. tertes, and so to tenne. The other deuision of the zodiacke is, by latitude or breadth. By latitude it is deuided into xii. degrees, and in it we imagine a lyne that deuideth his latitude by the myddest, hauing vi. degrees on euery parte or syde. And thys lyne, whyche deuideth into two equall partes the breadth or latitude of the zodiacke, is called the Eclyptike lyne, because that when the Sunne and Moone are directly deuided vnder thys lyne, eyther ioyned togeather by coniunction, or deuided by opposition, then is the Eclipse of the Sunne or of the Moone. Vnder this zodiacke the seuen planets are mooued. The Sunne also mooueth in the myddest of the sayde zodiacke, alongest the Eclyptike lyne, not enclyning more to the one part then to the other. But the other Planettes do sometyme goe towarde the North, and otherwhyles towarde the South, and sometyme also towarde or trauerse the Eclypryke. It is lykewyse to be noted, that these signes whereof we haue spoken, are not the constellations or starres that make those figures, whiche the auncient Astronomers vsed appropriate to certayne Beastes, and other thynges: For these figures are mooued according to the motion of the eight Sphere, and passe from one signe of the zodiacke to another. As we see that the Starre, called Oculus Tauri,

how the Sun is cause of generation and corruption.

Deuision of the twelue Signes.

Deuision of the signes into degrees.

Deuision of the zodiacke by latitude.

The Eclipticke lyne.

The mooning of the Sunne and the other Planets in the zodiacke.

that

(that is) the Bulles eye, is in two degrees of Gemini. And the two Starres that are the head of Gemini, are in xiii. and xvi. degrees of Cancer. And Spica verginis (that is) the spyke of the Virgin, is in xvi. degrees of Libra, and the hart of Scorpio, in two degrees of Sagittarius. And by this ꝙder do they passe frō one signe to another: so that we may not vnderstand the signes by these starres, but the xii. partes of the Arke of the Zodiacke, taking the begynnyng of the Equinoctiall of Aries. The names of these signes, with theyr Caractes and qualities, are described in this table heere folowyng.

The figures of beasts and other things imagined in heauen besides the xii. signes.

Numb.	Names.	Charact.	Qualities.
1	Aries.	♈	Hot and dry.
2	Taurus.	♉	Cold and dry.
3	Gemini.	♊	Hot and moyst.
4	Cancer.	♋	Colde and moyst.
5	Leo.	♌	Hot and dry.
6	Virgo.	♍	Colde and dry.
7	Libra.	♎	Hot and moyst.
8	Scorp.	♏	Colde and moyst.
9	Sagitt.	♐	Hot and dry.
10	Capri.	♑	Colde and dry.
11	Aqua.	♒	Hot and moyst.
12	Pisces.	♓	Colde and moyst.

The xii. Chapter, of the Circles, called *Coluri*.

THere are two circles in the Sphere, called Coluri, so named of the Greeke woorde Colon, whiche signifieth, a member: And of Vros, whiche signifyeth a wylde Ore. The tayle of this beast, maketh a Sempycircle, or halfe Circle, not perfecte. And as this beaste mouyeth his tayle laterally or syde wayes, and not by longitude: euen so do the Coluri moote to vs, and are cut in ryght spherical Angles, vpon

vpon the Poles of the world. The one palleth by the Poles of the world, and by the poynts of the Equinoctials, and is called the Equinoctiall Colure: the other lykewyse palleth by the Poles of the worlde, and also by the Poles of the Zodiacke, and by the poynts of the Solstitialles, and is called the Colure Solsticiall, called Solstitium, as Solis statio (that is) the standing or staying of the Sunne: because that when the Sunne commeth to this poynt, it declyneth no more, but turneth toward the Equinoctiall. These circles deuide aswell the Equinoctiall, as the zodiacke into foure equall partes, by the poyntes of the Equinoctialles, and Solstitialles. In the Colure Solsticiall, are the greatest declinations of the zodiacke, which are two Arkes of this Colure, conteyned betweene the Equinoctiall and the zodiacke. And these Arkes are equall to the other two of the same Colure, included betweene the Poles of the world, and the Poles of the zodiacke.

The Equinoctial Colure.

The Solstitiall Colure.

The greatest declination of the Zodiacke.

The xiii. Chapter, of the Meridian Circle.

THE Meridian, is one of the greate Circles, imagined to trauerse the sphere by the Poles of the worlde, cutting the same in two equall partes by the zenith or verticall poynt. It is called Meridian for this effect, that whersoeuer a man becommeth, and at what soeuer tyme of the yeere, when the Sunne (by the mouyng of the fyxte moueable) shall come to hys Meridian, to hym shall it be hygh noone at mydday, and is therefore also called the circle of the mydday.

Definition of the Meridian Circle.

The mydday or noone.

Ie

Diuers Meridians.

It is also to be noted, that there are as many Meridians, or Meridian lynes, as are differences or habitations by longitude: so that they that dwell in the East, haue other Meridians then they that dwell in the West: So that the interpolition of the arke of the Equinoctiall, betweene the Meridian of one Citie, and the Meridian of the other, is called the difference of longitude from one Region to another, and from one Citie to another, as we shall further declare hereafter.

The xiiij. Chapter, of the Horizontall Circle.

Definition of the horizon.

THe Horizon (after the Astronomers) is a Circle whyche deuydeth that parte of the heauen whyche wee doo see, from the other parte whiche wee see not, so that the sayde Horizon deuideth the Sphere of the worlde into two equall halfes, called Hemispheres. The halfe whiche wee doo see, is called the Hemisphere superior, and it whiche wee see not, is called the Hemisphere inferior. This Horizon, chaungeth to them that mooue: for as one doth mooue, hys Horizon doth chaunge. And heereof it commeth, that how many places are vppon the earth, and the circumference thereof, it is possible there should be so many Horizons. The Astronomers suppose the Horizon, after two maner of sortes, that is to say, a ryght Horizon, and an oblique, or crooked Horizon. The ryght Horizon, is to them whose zenith or verticall poynt is directly in the Equinoctiall: and thys ryght Horizon, passeth by the Poles of the worlde, and deuideth the Equinoctiall in ryght spericall angles. The other oblique or declyned Horizon haue they, vnto whome the Pole of the worlde doth ryse aboue they Horizon. This Horizon is also called oblique, because it deuideth the Equinoctiall in vnequall and oblique or crooked angles.

hemisphere or horizon.

Diuers horizons.

The ryght and oblique horizon.

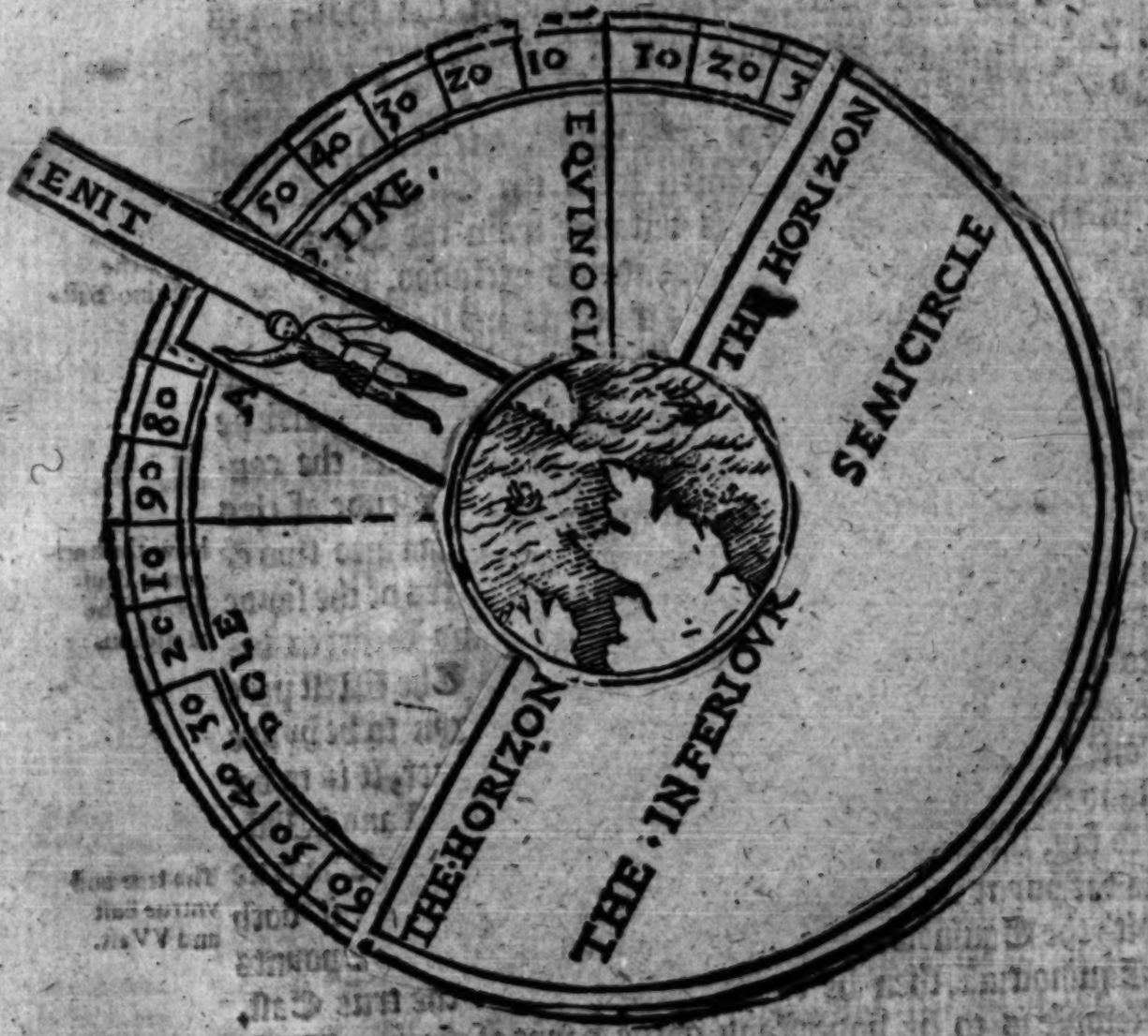
Also it is to bee vnderstoode, that the Pole of the Horizon is called Zenith, or the verticall poynt of heauen, perpendiculerlye, or directly ouer our head. Whereby is inferred, that as much as is the eleuation of the Pole of the world aboue the Horizon, so much is the distaunce of the Zenith from the Equinoctiall. For the Zenith by all his partes, is distaunt from the Horizon by nientie degrées. And all other impediments excluded, we may euer sée halfe the heauen: And in as much as any shall passe from the Equinoctiall, toward the one Pole or the other, so much sailech the Horizon vnder or beneath the Pole, toward the course he entendeth, and likewise as much shall it be rayſed aboue the contrary Pole, as shall appeare by a demonstration in the ende of this Chapter. This Horizon is diuided by the Meridian into two equall partes, that is to say, the East and West partes of the sayde Horizon. The East part is, where the Sunne and Starres begynne to arysse to vs, and appeare in our syght. The West part is, where the Sunne and Starres doth set and begyn to be hydde out of our syght, vnder the sayde Horizon. Moreouer, it is to bee vnderstanded, that there be two manners of the East and West, that is to say, the true East and West, or the vntrue. The true East, is the poynt in the East part of the Horizon, where it doth cutte with the Equinoctiall: for when the Sunne is in the poynts of the Equinoctiall, then he ryseth in the poynt of the true East. And lykewyse is to be vnderstand of the poynt of the true West, to be in the West part of the Horizon, where the Equinoctiall doth cutte with the sayde Horizon. The vntrue East and West is variable, accordyng as the Sunne ryseth and setteth dayly in dyuers poynts of the Horizon, which is distant from the poyntes of the true East and West, sometymes more to the Northward, and sometymes more to the South.

Distance of the zenith from the Equinoctiall.

how the herizon is deuided by the Meridian.

The true and vntrue East and VVest.

The



The xv. Chapter, of the foure leſſe Circles.

HAuing entreated of the vi. biggeſt Circles, it remayneth to ſpeake of the foure leſſe Circles.

The leſſe Circles.

A leſſe Circle (as we haue ſayde before) is that, whoſe ſuperficiall diuideth the Sphere into vnequall partes, not paſſing by the Center thereof.

ok. And of these, two are named Tropikes: so named of Tropo the Greeke word, which signifieth *Conuertion*, because the Sunne comming to any of these Tropikes, is conuerted, and turneth toward the Equinoctiall. These Tropikes are described by the motion of the fyxt moueable, with the poynts of the Solstitials. The one with the beginning of Cancer, and this is called the Tropike of Cancer, or Estiuall, or Sommer Tropike: The other is described with the beginning of Capricorne, and is called the Tropike of Capricorne, or Hiemall, or Winter Tropike. These two Tropikes and the Polar Circles (whereof I will say more heereafter) are called Paralelles: so named, for that they are equally distant by their circumferences one from an other, as well as from the Equinoctiall. The Polar Circles are described in this manner: so that as the Zodiacke declineth from the Equinoctiall, so do the Poles of the Zodiacke decline from the Poles of the world. And as the eyght Sphere is mooued at the motion of the fyxte moueable, so shall the Zodiacke moue, whiche is parte of the Sphere. And the Zodiacke being mooued, his Poles shall lykewyse moue aboue the Poles of the world. And as the Poles of the Zodiacke are distant from the Poles of the world xxiii. degrees and a halfe (which is as much as the greatest declination) they shal describe certayne circles distaunt from the Poles of the world, in the selfe same xxiii. degrees and a half. These Polar Circles, take their name or dominion of that Pole of the world that is most neere vnto them, and therefore is the one called Artyke, and the other Antartyke.

Tropykes.

Paralelles.

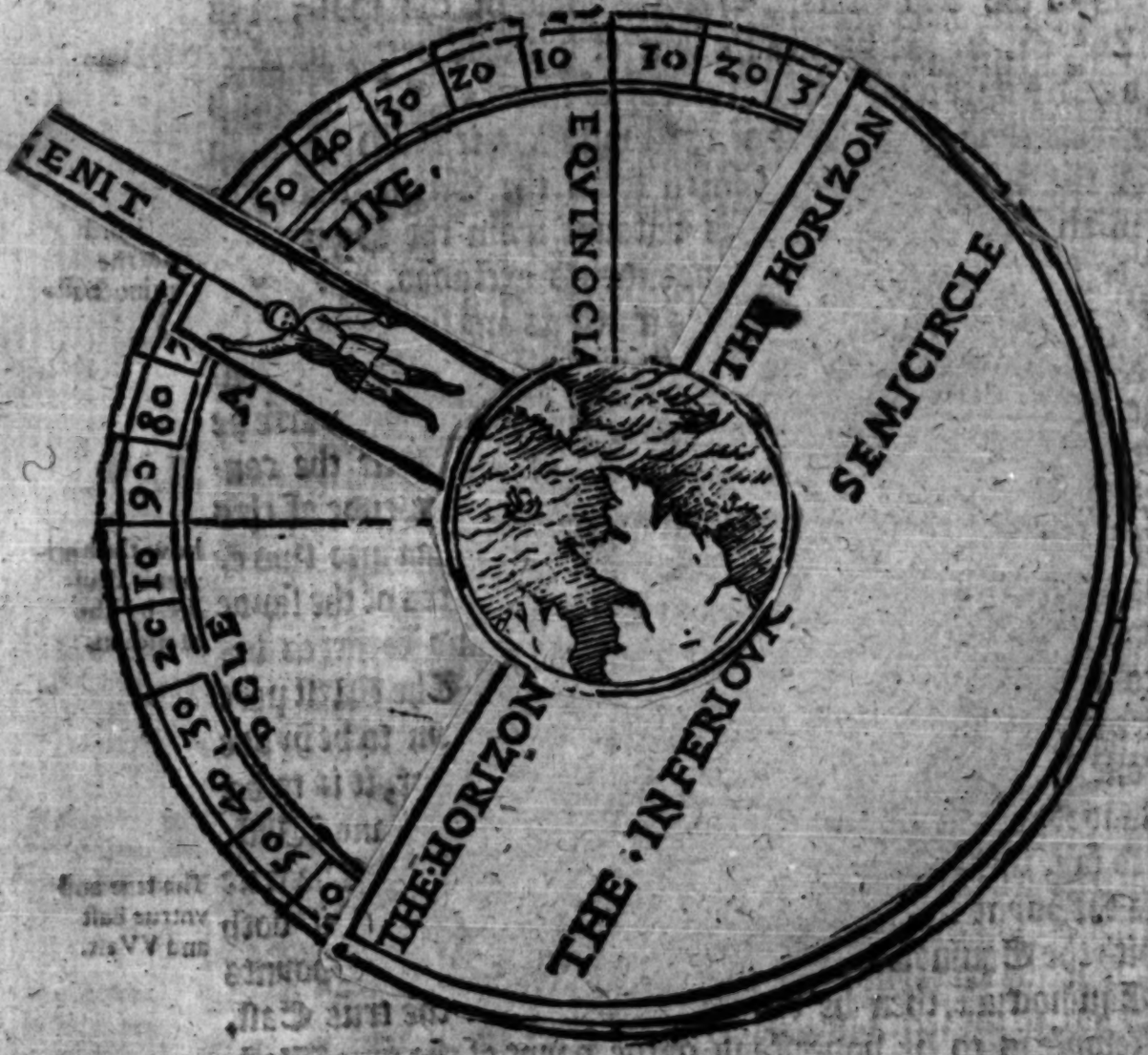
The Polar Circles.

The Poles of the zodiacke, and Poles of the world.

The greatest declination of the Sunne.

The Artyke, and Antartike.

The



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Tropykes.

Paralelles.

The Polar Circles.

The Poles of the zodiacke, and Poles of the world.

The greatest declination of the Sunne.

The Artyke, and Antartike.

The

The xvj. Chapter, of the fyue Zones.

THE auncient Aſtronomers diuided the Sphere into v. Zones. The firſt, from the Pole Artyke, to the Circle Artyke. The ſecond, from the Circle Artyke, to the Tropike of Cancer. The thyrde, from the Tropike of Cancer, to the Tropike of Capricorne. The fourth, from the Tropike of Capricorne, to the Circle Antartike. The fyfth, from the Circle Antartyke, to the Pole Antartyke. Of theſe fyue Zones, they haue certayne knowledge, that two of the Poles were vnhabitable for extreame colde: and alſo that the burnt Zone (called Torrida Zona) whereby the Sunne palleth by the middeſt of them, ſhould be vnhabitable for extreame heate. That from the Tropike of Capricorne, vnto the Circle Antartyke, they called deſart, becauſe they knew not that it was inhabited. And this our Zone, that is, from the Tropike of Cancer, to the Circle Artyke, they called inhabited, or habitable. And to haue more perfect knowledge hereof, it is to imagine, that the earth is diuided proportionally into fyue Regions or Portions, which anſweare directly to the ſayd fyue Zones, as ſayth the Poet Ouid in this Verſe.

The Sphere diuided into fiue zones.

Zones habitable and vnhabitable.

The diuiſion of the earth according to the fiue zones of heauen.

Totidemque plagæ, tellure præmuntur. (*That is*)
And ſo many Regions, are on the earth beneath.

Euery of theſe Regions or portions of the earth, is ſituate vnder one of the fiue Zones aforeſayd. But whereas certayne men of authoritie haue moued the queſtion, whether the earth vnder the Zone, from the Tropike of Cancer, to the Circle Antartyke, is deſart or no: Ptolomie, and the Aſtronomers affyrme, that it is vnpeopled. But Ariſtotle, Ouid in the ſecond of his *Metamorphoſes*, Plinie alſo, and Iohn de Sacro boſco, affyrme the contrary: as for the more certaintie thereof we knowe the experience of ſuch as goe and come dayly from thoſe partes. Moreouer then this, we knowe that that lande is not onely well repleniſhed with people of good compoſature, and of white colour, but the ſame to be alſo very rych in Golde. For they that ſayle to the Eaſt Indies,

An errour of Ptolomie and the Aſtronomes.

touche

touch in the caye of Buena speranza, or Caput bone Spei, which is in this Zone. Likewyse the land of Brasile, and the contynes of Rio de la Plata, with all the coast, vnto the straights of Magalianes, euen vnto the 54. degrees of the south part. This lande was discouered by Magalianes, in the yeere 1520. & 1521. wher eby that is now well knowen by sight, whereof Ptolome had no knowledge by heare say. The burnt Zone (called Torrida Zona) they also described to be vnhabitable, by reason of the greate heate thereof, as Aristotle, Plinie, and in maner all other ancient authors affirme: whereof the Poet Virgil wryteth thus.

The land of Brasile.
The straights of Magalianes

Quinque tenent cœlum Zone, quarum vna corrusco.
Semper sole rubens, & torrida semper ab igne.

Which in the English tongue is thus much to say in effect.

In Zones fyue, the heauens conteyned be,
Wherof the one with burning Sunne is red:
Scorching the Earth subiect to his degree,
That for the heate thereof it is vnhabited.

Lykewyse Ouide in his Metamorphoses, toucheth the same, saying.

Quarum quæ media est, & torrida semper ab igne. &c.

Yet that the burnt zone is inhabited, and well replenyshed wyth people that lyue there, we knowe so certaynely by the number of them that dayly passe too and fro the Indies of your Maiestie discouered, in your most happie dayes, that to say any thing to the contrary, it should be a manifest errour, and therefore is it greatly to be maruey led, that certayne wise men haue affirmed these parts to bee vnhabitable: whereas neuertheless they had knowledge of Arabia, Fœlix, Aethiopia, Tabrobana, and dyuers other Regions situate vnder the burnt Zone. Plinie wryteth, that a Ship came from the sea of Persia by the Ocean, round about Ethiope, and came to the pyllers of Hercules, which is now the Citie of Cadiz, where at this present I write this briefe treatise. They of Guinea, Calicut, Gatigara, and Malaca, lyue all vnder the burnt Zone, and many of them lyue very long. And doubtlesse, many things ought to perswade vs, that vnder the burnt zone, the earth is furnished with all thynges pertayning to the lyfe of man: for that in that region, or portion of the earth, is in maner

The Weſt Indies.

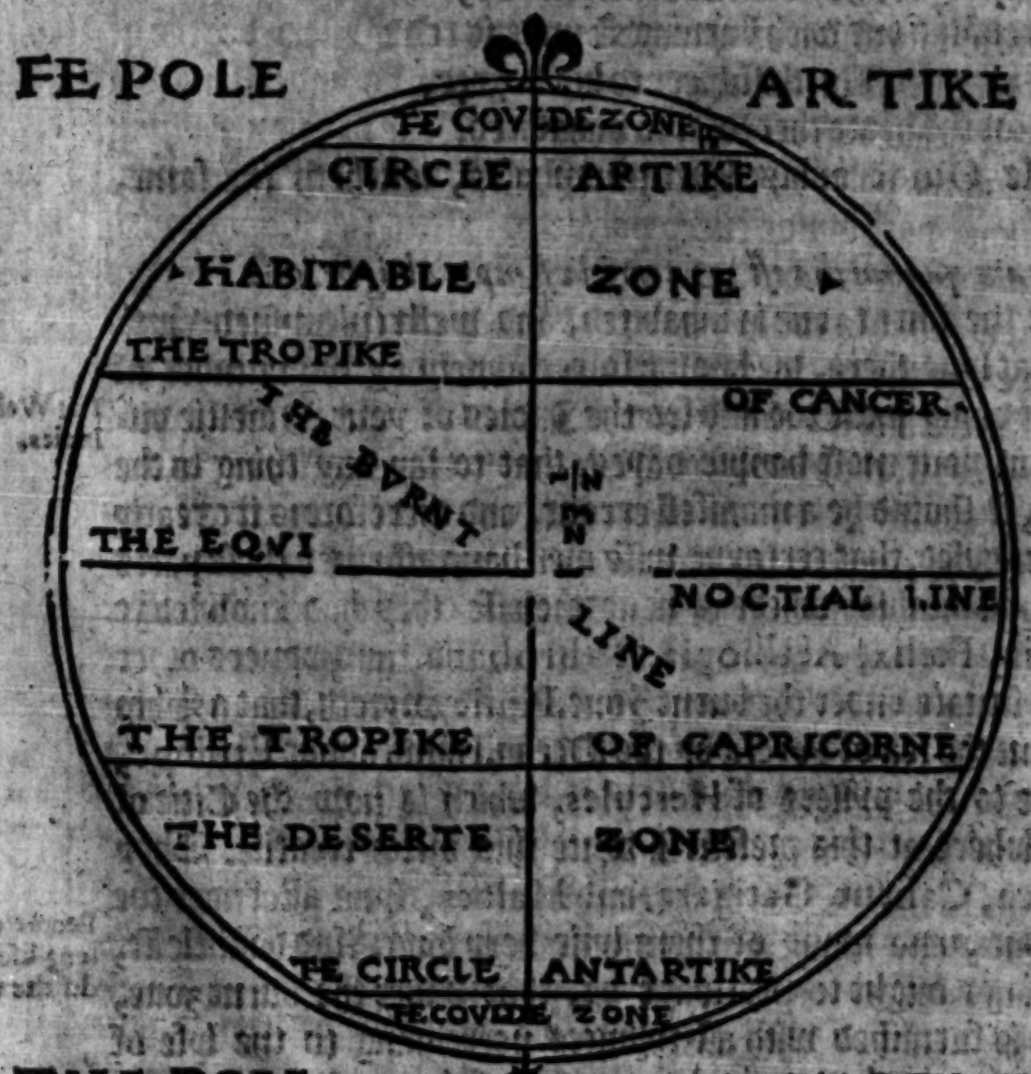
People of long life vnder the zone.

continuall Equinoctiall, and the coldnesse of the night doth sufficiently temper the heate of the day. Agayne, they that inhabite vnder that Zone, haue two Sommers, and two Winters in the yeere: whereby is concluded that the auncient aucthours erred, not onely in affyrming this Zone to be vnhabitable by reason of the great heat thereof, but in lyke maner erred, in affyrming the Zone that is betweene the circle Articke, and the pole Articke, to be also vnhabited by reason of great cold. The contrary whereof, we may well affyrme, knowing as we knowe, that Island, with part of Gothland, Norway, Russia, and dyuers other Lands, are inhabited and well peopled.

Cold Regions habitable.

Island. Gothland. Norway. Russia.

This is the figure and demonstration which foloweth.



The xvij. Chapter, of longitude and latitude, and of the proportion which the lesse circles haue to the great circle.

THE Sphere or globe of the earth, is also diuided in breadth, and in length. The breadth (which is called latitude) is by degrees: for from the Equinoctiall, to eyther of the two poles, is 90. degrees. The length (which is called longitude) is by the degrees of the Equinoctiall, which is diuided in 360. degrees. The fyrst degree of longitude, doth begin at a certaine Meridian, which passeth by the Ilands of the Canares, called the fyred Meridian: and the order of the numbring of the sayd longitude, is alwayes toward the East. By euery degree of the sayd longitude in the Equinoctiall, may be vnderstanded a great circle (called Meridian) to passe, eche one of them passyng and meeting the poles of the world, so that the sayd great circles, or meridians, doth diuide euery paralel or lesse circle, proportionally into 360. degrees: but we must not vnderstand these degrees to be equall (that is to say) as great in one circle, as in another: for the greater the circle is, the greater is the degree in it: and the greater the paralel is, the nearer it is vnto the Equinoctiall lyne. Euery degree of the Equinoctiall, conteyneth in longitude 60. minutes, so likewise it is to be vnderstanded of the degrees of latitude, which be diuided eche one into 60. minutes of latitude, because the degrees and minutes in the great circles, doo not differ in theyr bignesse the one from the other: but the degrees in the paralels, as they are distaunt from the Equinoctiall, and come neare to eyther of the two Poles, they diminish consequently, so that one degree in the paralel, of 7. degrees of latitude, doth make in quantitie but 59. minutes, and 33. seconds of the Equinoctial circle: and to one degree in the paralel of 12. degrees of latitude, goeth but 58. minutes, and 41. seconds of the Equinoctial, and to one degree in the paralel of 16. degrees of latitude, there goeth 57. minutes, and 41. seconds.

The diuision of the Sphere by longitude and latitude.

The degrees of the Equinoctial circle.

The Table of minutes, which euery degree conteyneth in euery of the paralelles.

G	M	S	G	M	S	G	M	S	G	M	S	G	M	S	G	M	S
1	59	59	16	57	41	31	51	26	46	41	41	61	29	5	76	14	31
2	59	58	17	57	23	32	50	53	47	40	55	62	28	10	77	13	30
3	59	55	18	57	4	33	50	19	48	40	9	63	27	14	78	12	28
4	59	51	19	56	44	34	49	45	49	39	22	64	26	18	79	11	27
5	59	46	20	56	23	35	49	9	50	38	34	65	25	21	80	10	25
6	59	40	21	56	1	36	48	32	51	37	46	66	24	24	81	9	23
7	59	33	22	55	38	37	47	55	52	36	56	67	23	27	82	8	21
8	59	25	23	55	14	38	47	17	53	36	7	68	22	29	83	7	19
9	59	16	24	54	49	39	46	38	54	35	16	69	21	30	84	6	16
10	59	5	25	54	23	40	45	58	55	34	25	70	20	31	85	5	14
11	58	54	25	53	56	41	45	17	56	33	33	71	19	32	86	4	11
12	58	41	27	53	28	42	44	35	57	32	41	72	18	32	87	3	8
13	58	28	28	52	59	43	43	53	58	31	48	73	17	33	88	2	5
14	58	13	29	52	29	44	43	10	59	30	54	74	16	32	89	1	3
15	57	57	30	51	58	45	42	26	60	30	0	75	15	32	90	0	0

The xviii. Chapter, of the circuite or compasse of the *Earth and Water, according to the opinion of the auncient and latter authours.*

IT may heere appeare to be necessarie for our purpose, to declare what space of the superficie of the earth or water, the auncient wryters dis suppose to answeare to one degree of a greater circle in the heauen: for in diuers countries, they vsed to count by diuers sorts of measures: as, the Latines counted by miles, the Greeks by furlongs, the Spanyards & Frenchmen by leagues, the Egyptians by signes or marks, and the Persians by

Myles. Furlongs. Leagues.

by saguas. But they all agree, that seuen graynes of Barly make a finger breadth, four fingers, a hand breadth, four hands a foote, fiue foote, a Geometricall pase (for two simple pases, make fiue feete.) Also 125. Geometricall pases, make a furlong, eyght furlongs, one myle, whiche is a thousand pases: and three myles, one league. In Germanie they make leagues of more feete, and in some places more then in other. In Fraunce, they count thyrtie leagues, to one degree. The Spanyards, count sixteene leagues and two terces, and seuenteene and a halfe for a degree of the great circle: this difference that one league is bigger then another, may come hereof, that one Barly corne is bigger then another. But to our purpose, let vs geue to euery league three thousand pases, and to euery pase fyue foote, and so shall euery league haue xv. thousand foote. In the Cardes of the sea, that haue their degrees of xvi. leagues and two terces, we say, that of these, the roundenesse of the land and the water conteyneth sixe thousande leagues. And in the Cardes that haue seuenteene leagues and a halfe for a degree, of these we say that it conteyneth sixe thousand and three hundred leagues. And who so desyreth to knowe howe muche is the Diameter of the earth and water, may knowe it by multiplying the circumference by seuen, so that diuiding the summe that riseth thereof by twentie and two, the part that ryseth of that calculation, shall be the Diameter: and the halfe thereof, shall be the semidiameter.

Grayne. Pynger. Foote. Pase.

The degrees of the sea Cardes.

The diameter of the earth and water.

The xix. Chapter, of the seuen Climates.

THE auncient authours did also diuide that part of the superficie of the earth, on the North side of the Equinoctiall, which they supposed to be most habitable, into seuen Climates, wherein they did fynde to be dyuers conditions and customes of men, and diuersities of beastes, and of other naturall thynges: the whiche

Diuision of the earth and water by Climates.

Diuersities of thyngs in diuers Climates.

thyngs they perceyued to haue a diuerſitie in the countreys, as where the day of the one did encreaſe or differ aboue the day of the other by halfe an houre, ſo that the ſpace of the ſuperficiall of the earth betweene two paralelle lynes, wherein the longeſt day doth increaſe or differ by halfe an houre, is called a Climate. The place where they ſuppoſe the fyrſt climate to begin, is diſtant in Latitude from the Equinoctial by 12. degrees, and 45. minutes, where the longeſt day is 12. houres, and 45. minutes, & the place where the laſt climate doth finiſhe, is in the Latitude of 50. degrees, and 30. minutes, where the longeſt day is 16. houres, and 15. minutes, ſo that the increaſe of the longeſt day in the ende of the ſeuenth climate, dooeth exceede it in the beginning of the fyrſt climate by three houres and an halfe: and the whole compaſſe of the earth, with all the ſeuen climates, dooeth conteyne in breadth 37. degrees, and 45. minutes, but their length is ſuppoſed to extend to 180. degrees of longitude. In that maner, a climate, the neare it is vnto the Equinoctial, the more it conteyneth of the ſuperficiall of the earth, becauſe the paralelle circles, the nearer they be vnto the Equinoctial, the greater is the compaſſe of the earth which they make in length, and the leſſer the compaſſe is, the nearer they be vnto the poles, as dooth appeare euidently by the Meridians, where they doo all concurre, and meete in the poles, their diſtaunces waxeth continually leſſer and leſſer, the nearer they be vnto the ſayd poles, ſo that the nearer the climate is vnto the pole, the leſſer it conteyneth of myles in the length. In lyke maner ſhall you vnderſtand, that greater is the breadth of the firſt clime, then of the ſecond, and the ſecond then the third, and lykewyſe of the other. For in how much the more the Equinoctial you come neare to the pole, ſo much the more is the Sphere oblique or crooked, and conſequently the day encreaſeth more: by reaſon whereof, in leſſe ſpace is found the increaſeth of halfe an houre, in which the climate maketh difference and doth varye. Whiche thyng ſhall be more manifeſt to hym that beholdeth the Latitude of them all, as may appeare by the Table heere folowyng: In whiche you may ſee the houres whiche the greateſt daye conteyneth of euery climate in his beginning, middeſt, and ende.

What is a climate.

Difference of dayes.

The ſpace of ſeuen climates

The quantitie of the leſſe circles.

The Latitude of Climates.

ende, with also the eleuation of the Pole, or distaance from the Equinoctial, and also the degrees of Latitude, which euery Climate conteyneth.

Climates.	The longest day. Beginning.		Midst.		End.		The eleuation of the Pole. beginning.		Midst.		End.		Differences of the latitude.	
	ho.	ℳ	ho.	ℳ	ho.	ℳ	°	ℳ	°	ℳ	°	ℳ	°	ℳ
1	12	45	13	0	13	15	12	45	16	40	20	30	7	45
2	13	15	13	30	13	45	20	30	24	15	27	30	7	0
3	13	45	14	0	14	15	27	30	30	45	33	40	6	10
4	14	15	14	30	14	45	33	40	36	24	39	0	5	20
5	14	45	15	0	15	15	39	0	41	20	43	30	4	30
6	15	15	15	30	15	45	43	30	45	24	47	15	3	45
7	15	45	16	0	16	15	47	15	48	40	50	30	3	15

Dia Meroe.

The fyrst Climate, is called Dia Meroes. Meroe is a Citie of Aphrike, vnder the burnt Zone, on this side the Equinoctiall, 16. degrees.

Dia Siene.

The second, is called Dia Siena. Siena is a Citie in the confines of Ethiope, where there is a well that sheweth the Sommer solsticiall, because that place is vnder the circle of the Tropike of Cancer, and the Sunne seemeth to stand directly ouer that place at mydday of the solsticiall, whereby the well is then very cleere, and hath in it no shadowe at all: as the Poet Lucan maketh mention in Farsalia, where he sayth.

Vmbras nusquam flectentes.

That is to say, Shadowes no where reflecting.

Dia Alexandros.

The thyrd is. Dia Alexandros. Alexandria is a famous Citie in Aphrike, buylded by great Alexander, and is the cheefe Citie or Metropolis of Egypt.

Dia Rhodos.

The fourth is, Dia Rhodos. Rodes is an Iland of Asia the lesse, where were sometyme the Knyghtes of the Rhodes, called the Knyghtes of the order of Saint John, or Knyghtes of Hierusalem, who were vtyuen from thence, when the Iland and Citie was taken by Solton Suliman the greate Turke, in the yeere 1522. Philippe Vrlerio Frencheman,

knightes of the Rhodes.

The Rhodes taken by the Turke.

beyng then graund Maister of the Rhodes. Within this fourth Climate, is the Citie of Hierusalem, within the holy land called Palestina, and also a great part of Spayne, with many other Prouinces.

Dia Romes. The fyfth, is Dia Romes. Rome is the most famous Citie of Italie, and most notorious of all Europe, sometyme the head of the worlde, dommatrix of Nations, and now the See of the Byshop of Rome.

Dia Boristhenes. The syxth, is Dia Boristhenes. Boristhenes is a great Riuer of Scithia, the fourth arme of the riuer Istro. It falleth into the sea Euxinum: and where as all other riuers of Scithia are troubled, this is cleere and fayre, also holesome to be drunke, and full of Fyshes.

Dia Rifeos. The seuenth, and last Climate, is called Dia Rifeos. The Mountaynes called Rifei, are famous in the part of Europe called Parmatia, and are contunually couered with Snow. Out of these, spryngeth the riuer Tanais, well knowen in the worlde by fame. When it is written with ph, it is the name of certayne Mountaynes of Archadia. And heere ought we not to be ignoraunt, that whereas the aucthours assigned onely seuen Climates, they might haue made many more. And for that they iudged the part of the Pole Antartike not to be inhabited, they assigned no Climates thereto. Stoflerine added the eyght Climate, counting from the ende of the seuenth Climate, vnto 57. degrees: and other added more. In like maner describing Meridionall or South Climates, we call them by the selfe same names, as we dyd the aforesayd Septentrionall, or North Climates: sauing that it is necessarie to put before euery of them thys Greeke proposition Anti, which in the Latin tongue signifieth Contra, or Contrarium, (that is) contrary, or against. So that as we named the fyrst North Climate, Dia Meroes, we must to the fyrst of the South, adde this word Anti, and so shall the fyrst South Climate be named Anti Dia Meroes: The seconde, Anti Dia Sienes, and so fourth of the other, as is seene in the Figure heere folowyng.

The riuer Tanais.

Stoflerine.

The Meridian or South Climate.

The

The xx. Chapter, of certayne principles, that ought to be knowen for this science.

IN treating of the Sphere, wee haue spoken of Circles, Circumferences, Centers, Diameters, Lynes, with such other words, appropriat to this science: The which, what they are, it is conuenient further to declare.

A right lyne, is a short extention from poynt to poynt. A right line.

An angle, is the touchyng of lynes in one superficiall, whose An angle.

whose touch shall not be direct: for if it be, it shall be a lyne, and not an angle. Solide is a body, which by deuisions hath length, breadth, and depth.

Solide.

A circle.

A circle is a playne figure, conteyned vnder a lyne drawne in compasse, in whose middest is a poynt or pricke, from the which all right lynes comming forth to the circular lyne that compasseth it about, are equall.

The circumference of a circle.

The circumference of a circle, is a lyne that conteyneth the circle, (that is to meane) that lyne to the which all ryght lynes that proceed from the center of the circle vnto it, are equall: and this is called the roundnesse of the circle.

The center of a circle.

The center of a circle, is that poynt or pricke from the which all ryght lynes proceeding vnto the circumference, are equall.

Diameter

The Diameter of a circle, is a ryght lyne, which passing by the center of the circle, and extending his endes to the circumference, diuideth it in two halfes.

Semicircle

The halfe circle, is a playne figure, conteyned betweene the Diameter of the circle, and the halfe circumference.

Zenith.

Zenith, is a poynt or pricke imagined in the heauen, directly ouer the toppe of any thyng, as if we should imagine a ryght lyne to passe by the center of the earth, extended from thence directly to heauen, and passing through the feete and head of a man standyng vpryght, so that the extremities or ends of this lyne, should reach vnto and touch the circumference of heauen: then the imagined poynt or pricke of heauen, where the ende of the lyne toucheth, is called Zenith, or poynt of the head, or verticall point. The same is to be vnderstoode of a Cittie, or any other thyng, when we speake of the Zenith thereof.

Eccentricke.

Eccentricke, is a circle, which hath his center distant, or diuided from the center of the worlde, and is described in the heauen of the Sunne, imagining a lyne from the center of the Eccentricke, to the center of the Sunne, making a complete reuolution at the proper motion of the Sunne, in the other heauens, imagining a lyne from the center of his Eccentricke, to the center of his Epicicle, and beyng mooued a whole reuolution at the proper motion of the

Epicicle.

The

The Epicicle, is a circle, or litle rundell fyxt in the deapth of the Eccentricke: in which the Planet fyxed, and neare to his center, is mooued circularly. *Epicicle.*

The Auge, is a poynt in the circumference of the Eccentricke, nearest vnto the firmament: or it may be sayde, that the Auge is a poynt fardest distant from the earth. Aux in the Greeke tongue, is as muche to say, as the greatest longitude, or greatest elenation from the earth. The Oppolite of Auge, is an other poynt in the circumference of the Eccentricke, nearest vnto the earth, and fardest distant from the firmament. *Auge.* *Oppolite of Auge.*

¶ Here endeth the first part.

¶ The seconde part, intreating of the *motions of the Sunne, and the Moone,* and of the effectes caused thereby.

¶ The fyrst Chapter, of the course of the Sunne in the Zodiacke, and the effectes caused by the same.

WE haue briefly spoken of the Sunne, and of the other heauens. But for as muche as the Sunne must bee our marke, guide, and gouernour in Nauigation, whereof we intend to geue perfect instructions, it shalbe necessarie especially, and precisely, to declare the course and motions thereof. *The Sunne is the guyde in Nauigation.*

Therefore (as we haue sayd) the Sunne is mooued vnder the Zodiacke, and vpon his poles in the lyne Eclipticke, passing by the xii. signes, beginning in the fyrst degree of Aries, where he maketh *The mooving of the Sunne vnder the zodiacke.*

keth Equinoz, that is to say, he maketh the day equall vnto the nyght in all places. Then from Aries, he entreth and mooueth into Taurus, approching nearer and nearer vnto vs on the Noꝛth part, whereby the length of the dayes are increased with vs, and the nyghtes are shoꝛtened. Then entreth he into Gemini, and from Gemini into Cancer, where in the beginning of the first degree he maketh Solstice, and toucheth the Sommer oꝛ Estiuall Tropike, and then are the dayes longest with vs, and the nyghtes shoꝛtest. Then declyneth he no farther from the Equinoctiall: but returning towarde it, passeth by this signe, shoꝛtening the dayes to vs, and lengthening the nyghtes. From thys signe of Cancer, it entreth into Leo, and passeth by it into Virgo, and by it entreth into the first degree of Libra, where he is in the Equinoctiall, and then he maketh the other Equinoꝛ, so that the nyght is then equall vnto the day ouer all the worlde. And passyng by this signe, goeth declyning from the Equinoctiall towarde the pole Antarctike, increasyng the nyghtes to vs, and shoꝛtening the dayes: and so entreth into Scoꝛpio, and from thence into Sagittarius. And passyng by it, entreth into the fyrst degree of Capꝛicoꝛne, to the Hyemall oꝛ Winter Tropike: and then are the longest nyghtes vnto vs, and the shoꝛtest dayes. From hence he returneth towarde the Equinoctiall, shoꝛtening vnto vs the nyghtes, and lengthening the dayes. He passeth by thys signe of Capꝛicoꝛne, and entreth into Aquarius: and passyng by it, entreth into Pisces: and passyng from thence, returneth to hys fyrst poynt of the Equinoctiall of Aries, where he began. Hereby it followeth, that as the Sunne goeth the halfe of the Zodiacke on thys part of the Equinoctiall, and the other halfe on the other part of it, and in these halfes hath diuers declinations, is caused the increasing oꝛ decreasing of the dayes and nyghtes, to one moꝛe, and to another lesse, accoꝛdyng as euery one with his Hoꝛizon discouereth of the course of the Sunne, by the lytle oꝛ muche that he is departed oꝛ distant from the Equinoctiall, oꝛ as the pole is raysed aboue his Hoꝛizon. So that when as to them that are on this part of the Equinoctiall, is the longest day and the shoꝛtest nyght: euen so to them on

The Sommer Tropicke. Declination of the Sunne.

The Winter Tropike.

The cause of increasing and decreasing of the day and nyghtes.

on the other part, is the longest nyght, and shortest day. And contrarywise, when vnto vs is the shortest day, vnto them is the longest, which shall further appeare by euident demonstration in the last Chapter of the thyrd part.

The discreete Reader shall heere note, that the Sunne is not mooued regularly in the Zodiacke, making so much by his proper motion in one day, as in the other, because his reguler motion is in respect of the center of his owne proper sphere or orbe wherein he is mooued, whose center is distaunt without the center of the world, toward that part of Cancer, so that the greater part of his orbe eccentricke, is toward the septentrionall part, where the Sunne passyng by the septentrionall signes, is more distaunt from the earth, and hath more to goe of his orbe eccentricke, then being in the South signes: for passyng by the North signes, he taryeth nyne dayes more, to describe that halfe of the Zodiacke, then the other halfe toward the South part, and for that cause the Sunne is more swifter in his motion in the Zodiacke one time then another, for his motion in one day in the South signes, shall be greater then it is in one day in the North signes, as shall appeare in the table that followeth: whose vse is, for the fynding of the motion and true place of the Sunne in the Zodiacke for euery day of the yeere. And hereby it followeth of the sayd vnequall mouing of the Sunne, and by the obliquite of the Zodiacke, certayne dayes of Winter, with their nyghtes, are longer then certayne other of Sommer, with their nyghtes: that is to say, that the day naturall in the Winter, doth surmount that in the Sommer, because the ryght assension, which answeareth to one dayes motion of the Sunne, being in the South signes, is greater then the assension for one dayes mouing, being in the North signes.

The mooving of the Sunne in the center of his Sphere.

The

The ij. Chapter, of the true place of the Sunne in the Zodiacke.

To fynde the true place of the Sunne.

THE true place of the Sunne is a poynt or prick in the Zodiacke, which is thus found: that drawing a ryght lyne from the center of the world, to the center of the sunne, and carying the same continually right forth vnto the Zodiack, where this lyne sheweth or toucheth, that is the true place of the Sunne. This place is found in three maners. One way, by a table: another way, by an instrument: and the thyrde way, by a certayne rule, to be borne in memorie. To fynde the true place of the Sunne by a table, seeke in the table folowing, the moneth that you are in, in the front or head of the table, and the dayes of the moneth, on the left syde of the table. Then directly against the dayes, vnder the title of the monethes, you shall fynde two numbers, which are the degrees and minutes of the signe which you shall first fynde, named ouer the head, or aboue the sayde numbers. Then to the degrees and minutes whiche you shall fynde, you shal adde the equation, that is directly of the yeere in the which you are, or seeke to know. And this shall you seeke in the table of equations, which is after this: and that which doth amount or rise thereof, shall be the true place of the Sunne. And heere is to be noted, that in the common yeeres (which are they that haue not the biseptile or leape yeeres) from the ende of Februarie, vntyll the ende of the yeere (I say of December) shal euer one degree be diminished or taken away: and the degrees and minutes that shall remayne, is the true place of the Sun.

The equation of the yeere.

How to knowe this by an instrument and by memorie, shall be saide in the seuenth Chapter.

The

The Table of the true place of the Sunne.

Months	January.		Febyuary.		March.		Aprill.		May.		June.	
Signes.	Caprico.		Aquarius.		Piſces.		Aries.		Taurus		Gemini.	
Dayes.	☉	☽	☉	☽	☉	☽	☉	☽	☉	☽	☉	☽
1	20	22	21	53	20	55	21	24	20	21	19	55
2	21	24	22	54	21	55	22	22	21	18	20	52
3	22	25	23	54	22	54	23	21	22	16	21	49
4	23	26	24	55	23	54	24	19	23	11	22	46
5	24	27	25	55	24	53	25	17	24	13	23	43
6	25	28	26	56	25	53	26	16	25	8	24	40
7	26	30	27	56	26	52	27	14	26	6	25	37
8	27	31	28	56	27	52	28	12	27	3	26	34
9	28	32	29	57	28	51	29	10	28	0	27	31
10	29	33	☉♓	57	29	50	☉♈	8	28	58	28	28
11	☉♒	35	1	57	☉♈	49	1	6	29	55	29	25
12	1	36	2	58	1	48	2	4	☉♊	52	☉♋	22
13	2	37	3	58	2	47	3	2	1	50	1	19
14	3	38	4	58	3	46	4	0	2	47	2	16
15	4	39	5	58	4	45	4	58	3	44	3	13
16	5	40	6	58	5	44	5	56	4	41	4	10
17	6	41	7	58	6	43	6	54	5	38	5	7
18	7	42	8	58	7	42	7	52	6	36	6	4
19	8	43	9	58	8	41	8	49	7	33	7	1
20	9	44	10	58	9	39	9	47	8	30	7	58
21	10	45	11	58	10	38	10	45	9	27	8	55
22	11	46	12	58	11	37	11	43	10	24	9	52
23	12	47	13	57	12	36	12	40	11	21	10	49
24	13	48	14	57	13	34	13	38	12	18	11	46
25	14	48	15	57	14	33	14	36	13	15	12	43
26	15	49	16	56	15	32	15	33	14	12	13	40
27	16	50	17	56	16	30	16	31	15	10	14	37
28	17	51	18	56	17	29	17	28	16	7	15	34
29	18	51	19	56	18	28	18	26	17	4	16	31
30	19	52			19	27	19	23	18	1	17	29
31	20	52			20	25			18	58		

The Table of the true place of the Sunne.

Months	July.		August.		Septēber.		October.		Nouēber.		Decēber.	
Signes.	Cācer.		Leo.		Virgo.		Libra.		Scorpio.		Sagittari	
Days	☉	☽	☉	☽	☉	☽	☉	☽	☉	☽	☉	☽
1	18	26	18	♑	18	4	17	39	18	49	19	24
2	19	23	19	♑	19	2	18	39	19	50	20	26
3	20	20	19	58	20	1	19	38	20	51	21	27
4	21	17	20	55	21	0	20	38	21	52	22	29
5	22	14	21	53	21	58	21	38	22	53	23	30
6	23	11	22	51	22	57	22	38	23	54	24	31
7	24	8	23	48	23	56	23	38	24	55	25	33
8	25	5	24	46	24	55	24	38	25	56	26	34
9	26	2	25	44	25	54	25	39	25	57	27	36
10	27	0	26	42	26	53	26	39	27	58	28	37
11	27	57	27	40	27	52	27	39	28	59	29	39
12	28	54	28	38	28	51	28	39	♐	0	☉♑	40
13	29	51	29	36	29	50	29	39	1	1	1	42
14	☉♌	48	☽♍	34	☉♎	49	☉♏	39	2	3	2	43
15	1	46	1	32	1	48	1	40	3	4	3	45
16	2	43	2	30	2	47	2	40	4	5	4	46
17	3	40	3	28	3	46	3	40	5	6	5	48
18	4	38	4	26	4	45	4	41	6	8	6	49
19	5	35	5	24	5	45	5	41	7	9	7	51
20	6	32	6	22	6	44	6	42	8	10	8	52
21	7	30	7	21	7	44	7	42	9	11	9	54
22	8	27	8	19	8	43	8	43	10	12	10	55
23	9	25	9	17	9	42	9	43	11	13	11	57
24	10	22	10	16	10	42	10	44	12	14	12	58
25	11	20	11	14	11	41	11	45	13	15	13	59
26	12	17	12	13	12	41	12	45	14	16	15	1
27	13	15	13	11	13	41	13	46	15	18	16	2
28	14	12	14	10	14	40	14	47	16	19	17	3
29	15	10	15	8	15	40	15	47	17	20	18	5
30	16	7	16	7	16	39	16	48	18	22	19	6
31	17	5	17	5			17	49		22	20	7

The Table of the Equation of the Sunne.

The yeres of our lord	The equation to be added. G	☽	The yeres of our lord	The equation to be added. G	☽	The yeres of our lord	The equation to be added. G	☽	The yeres of our lord	The equation to be added. G	☽
1545	℞1	0	1581	1	16	1617	1	32	1653	1	48
1546		45	1582	1	1	1618	1	17	1654	1	33
1547		30	1583		46	1619	1	2	1655	1	18
1548		15	1584		32	1620		47	1656	1	3
1549	1	2	1585	1	18	1621	1	33	1657	1	49
1550		47	1586	1	3	1622	1	18	1658	1	34
1551		32	1587		48	1623	1	3	1659	1	19
1552		18	1588		33	1624		49	1660	1	4
1553	1	4	1589	1	19	1625	1	35	1661	1	51
1554		49	1590	1	4	1626	1	20	1662	1	36
1555		34	1591		49	1627	1	25	1663	1	21
1556		19	1592		35	1628		51	1664	1	7
1557	1	05	1593	1	21	1629	1	37	1665	1	53
1558		50	1594	1	6	1630	1	22	1666	1	38
1559		35	1595		51	1631	1	7	1667	1	23
1560		21	1596		37	1632		53	1668	1	9
1561	1	7	1597	1	23	1633	1	38	1669	1	55
1562		52	1598	1	8	1634	1	23	1670	1	40
1563		37	1599		53	1635	1	8	1671	1	25
1564		23	1600		39	1636		54	1672	1	10
1565	1	9	1601	1	25	1637	1	40	1673	1	56
1566		54	1602	1	10	1638	1	5	1674	1	41
1567		39	1603		55	1639	1	10	1675	1	26
1568		25	1604		40	1640		56	1676	1	12
1569	1	11	1605	1	26	1641	1	42	1677	1	58
1570		56	1606	1	11	1642	1	27	1678	1	33
1571		41	1607		56	1643	1	12	1679	1	28
1572		26	1608		32	1644		8	1680	1	13
1573	1	12	1609	1	28	1645	1	44	1681	℞2	⊙
1574		57	1610	1	13	1646	1	29	1682	1	45
1575		42	1611		58	1647	1	14	1683	1	30
1576		28	1612		44	1648	1	0	1684	1	15
1577	1	14	1613	1	30	1649	1	46	1685	2	2
1578		59	1614	1	15	1650	1	31	1686	1	4
1579		44	1615	1	10	1651	1	16	1687	2	32
1580		29	1616		46	1652	1	2	1688	1	8

This Table of the Equation of the Sunne, serueth from the yeere of 1545. where it hath hys roote or beginning, vntill 1680. and in the yeere of 1681. it shal returne to the roote, adding thereunto one degree more. As for example. In the yeere of 1681. adde one degree vpon the other degree that the roote hath, and so shall the yeere of 1681. haue two degrees of Equation, and the yeere of 1682. shall haue one degree, and 45. minutes, which is to adde one degree vpon 45. minutes, that had the yeere of 1546. &c. And hauing passed other 136. yeeres, you shall returne to the roote, adding two degrees.

The iij. Chapter, of the declination of the Sunne.

What is the declination of the Sunne.

THe declination of the Sunne, is the arcke of the greater Circle, whiche passeth by the Poles of the worlde, included betweene the Equinoctiall and the Zodiacke. And heere is to be noted, that whatsoeuer foure poynts or pyckes which are equally distaunt from the poynts of equinoxes (which are the beginnings of Aries and Libra) shall haue equall declinations.

Whereof it foloweth, that the foure quarters of the Zodiacke haue equall declinations. And to auoyde prolixitie, I will adde heerevnto a Table of the declinations of onely one quarter of the Zodiacke, so that all hauing one selfe same maner of declinations, it may serue for all, and the order of it is this. The signes whose declination increaseth, are in the head or front of the Table, and the degrees of these signes descend by the left side thereof. And the signes whose declination decreaseth, are in the foote of the Table, and the degrees of these signes, rise by the right side of the same. The disposition of the Table being vnderstood: then to knowe what declination the Sunne hath in euery degree of the Zodiacke, you ought to

Signes	♈	♌	♉	♏	♊	♐	Signes
	G	G	G	G	G	G	G
0	0		11	30	20	12	30
1	0	24	11	51	20	25	29
2	0	48	12	12	20	37	28
3	1	12	12	33	20	49	27
4	1	36	12	53	21	0	26
5	2	0	13	13	21	11	25
6	2	23	13	33	21	22	24
7	2	47	13	53	21	32	23
8	3	11	14	13	21	42	22
9	3	35	14	32	21	51	21
10	3	58	14	51	22	0	20
11	4	22	15	10	22	9	19
12	4	45	15	28	22	17	18
13	5	9	15	47	22	25	17
14	5	32	16	5	22	32	16
15	5	55	16	23	22	39	15
16	6	19	16	40	22	46	14
17	6	42	16	57	22	52	13
18	7	5	17	14	23	57	12
19	7	28	17	31	23	3	11
20	7	50	17	47	23	8	10
21	8	13	18	3	23	12	9
22	8	35	18	19	23	15	8
23	8	58	18	34	23	19	7
24	9	20	18	49	23	22	6
25	9	42	19	4	23	24	5
26	10	4	19	18	23	26	4
27	10	26	19	32	23	28	3
28	10	47	19	46	23	29	2
29	11	9	19	59	23	30	1
30	11	30	20	12	23	30	0
Signes	♌	♍	♎	♑	♓	♒	Signes

to know the true place of the Sunne (as in the Chapter past is declared) for the day of the declination which you desire to knowe, and the signe which the Sunne shalbe found in that day, shall you seek in the front or foote of the Table. And if it be in the front, you shall seeke the number of the degrees on the left syde. And if it shalbe at the foot of the Table, you shall seeke it on the ryght syde. Then aboue or vnder the signe, in the front of that degree of the sayd signe, you shall fynde twoo numbers, whereof the first is of degrees, and the second of minutes: and those degrees and minutes of declination the Sunne hath that day. And thys is vnderstoode without hauing respecte to the odde minutes aboue the degree, which the true place of the Sunne hath.

And if you desyre to verifie this more precisely, note the declination of that degree, and of the degree folowing: and take the lesse from the

more, and that which remayneth, shalbe the difference of the declination from the one degree to the other, of which difference yee shall take a part proportionally, as are the minutes of the place of the Sunne vnto 60. And this part of minutes must be added to the first declination of it, and be lesse then the second, or must be taken from it if it shall be greater, and then that riseth thereof, shalbe the precise declination for that signe, degree, and minute. As for example. In the yeere 1545. the tenth day of September, the Sunne shalbe in 26. G. 38. M. of Virgo, & to the 26. G. precise, shall correspond 1. G. 36. M. of declination. And to verifie the declination that commeth to 38. minutes, which is more of the 26. G. you must marke the difference that is from the declination of 26. G. (which is one G. 36. M.) to the declination of the 27. G. which is 1. G. 12. M. The difference is 24. M. Of these you must take such part proportionally, as the 38. minutes beareth vnto 60. which are almost two terces of a degree. Then the two terces of 24. are 16. which must be taken from one degree 36. M. which correspond to the 26. G. of Virgo, because the declinations goe decreasyng, and remayneth 1. G. 20. M. and if the declinations increase, you must adde thereto, as you take away when they decrease.

An other example for this yeere of 1561.

Example for the yeere 1561. the 20. of Aprill, I fynde the true place of the Sunne at noone, in 9. degrees 54. minutes of Taurus: then in the Table of the signes present, I seeke for 9. degrees of Taurus, to whiche doth answeare for the declination 14. degrees. 32. minutes, & to the next degree folowing, doth answeare 14. degrees 51. minutes: then take the lesser out of the more, so resteth 19. minutes. Then from a rule of 3. & say, if 60. minutes geue 54. minutes (which 54. minuts doth rest before of the 9. degrees of Taurus) how many doth 19. minutes geue? which 19. minuts are the diuersitie of the 9. & 10. degrees of Taurus. So I finde, that 19. minutes geueth 17. minutes, and 6. secondes, which 17. minutes, and 6. secondes, I adde to the 14. degrees 32. minutes, which answeareth to the 9. degrees of Taurus.

And

And it commeth to fourteene degrees. 49. minutes, and syxe secondes, which is the true declination for the twentie day of Aprill. Anno. 1561.

It is also to be noted, that I adde these seuenteene minutes and sixe secondes, because the declination doth encrease: for if it decreased, it were to be taken out so much, and the rest is the declination. So is the declination for the twentie of Aprill in the yeere 1561. fourteene degrees. 49. minutes, and syxe secondes.

The iiij. Chapter, of the encrease of the Sunne into the twelue Signes. And of the Equinoctials and Solsticials which deuide the foure tymes of the yeere.

IF that is sayd in the Chapter before, it followeth that the sunne entring into the foure principall signes, causeth the foure tymes of the yeere. For entring into Aries, it chaungeth the time to vs from winter to the spring time. And entring into Cancer, it chaungeth the tyme from spryng to sommer. And entring into Libra, from sommer to Autumne. Likewise entring into Capricorne, it chaungeth from Autumne to Winter. So that when to vs that be on the part of the North, is sommer, then is it winter to them that are on the South part. Or contrarywyse, being sommer to them on the South, it is winter to them on the North. The entrance of the sunne into these signes, and all other of the Zodiacke, hath not been euer at one selfe same tyme of the yeere. The cause of this is, that the Latine yeere is not equall with the mouing of the sunne in the Zodiacke, as shalbe sayd in the x. Chapter, where we wyl entreate of the yeere. In the tyme that Christ our redeemer was borne, were the Equinoctialles. The one at the eyght of the kalendes of Aprill,

The entrance of the Sunne into the foure principall signes.

The Latine yeere.

The Equinoctialles in the yeere of Christs byrth.

and the other at fyue of the kalendes of October: So that they had the Equinoctiall of the Spring, at the xxv. of Marche, and the Equinoctiall of Autumne, at the xxvii. of September, as writeth John Baptist Capuano, vppon the seconde Chapter of the Sphere of Iohan. De sacro bosco. They iudged then the Solsticialles, as that of the Sommer, at the eyght day of the kalendes of July, whych is the xxiiii. of June: the other of the Wynter, they iudged at the eyght day of the kalends of Januarie, which is the xxv. of December. And heere wyll I not omit to say how in those times, at these foure dayes (that is to meane, in the two Solstitialles and two Equinoctialles) were celebrated, and dyd chaunce foure marueylous thynges in the worlde.

The Solstitials.

For in the spring Equinoctiall, which was at the xxv. of March, the Sonne of GOD was incarnate, and afterwarde borne of the Virgin Marie in the Solstitiall of Wynter, wyche was at the xxv. of December.

Four notable thynges.

In the Equinoctiall of Autumne, whiche was the xxvii. of September, was conceyued blessed John Baptist, the cryer and preturlour of Christ: and was borne in the sommer Solstitiall, that was the xxiiii. of June. And this is the xyth Mynerly whereof Saint Luke speaketh in the Gospell. Wyche thyng also John Chrysostome doth verifie, saying that S. John was borne when the dayes began to decreale, and our Lorde when they began to increase. And it may certaynely seeme woorthie to be had in memorie, that in the sayde Equinoctiall of the spring, Christ suffered, Adam was created and loste the estate of innocencye, Abel was slayne, Melchisedech offered bread and wyne, Isahac by Abraham was brought to be sacrificed, John Baptist was beheaded at Macherunta, Peter delyuered out of prysom, Saint James beheaded by Herode, the good Theefe enioyed Paradise, and the bodyes of many Saintes rose wyth Christe. And who so further desyreth more precisely to knowe the entraunce of the Sunne into Aries, and into the other principall signes, shall in the thyrde parte of thys worke, in the eyght Chapter, fynde rules whiche shall bryng hym to the knowledge thereof. But to returne

To knowe more precisely the entraunce of the Sunne into the foure principall signes.

returne to our tyme, I say that thys present yeere of 1545. the Sunne entreth into the fyrste degree of Aries, at the tenth of Marche, at foure of the clocke at after noone, and into the fyrst degree of Taurus the nynth of Appyll 2. houres, and 7. minutes, and into Gemini the 11. of May 2. houres and fyre minutes, into Cancer the 11. of June. 14. houres. 44. minutes, into Leo the 13. of July. 3. houres. 50. minutes, into Virgo the 13. of August 9. houres 56. minutes, into Libra the 13. of September 4. houres 4. minutes, into Scorpio the 13. of October. 7. houres 13. minutes into Sagittarie the 12. of Nouember iust at noone, into Capricorne the 11. of December 8. houres 16. minutes, into Aquarius the 9. of Januarie. 2. houres, one minute, into Pisces the 8. of Februarie 1. houre 30. minutes after midday (that is to say) from noone 1. houre 30. minutes. And that we may in the yeeres to come, knowe the day, houre, and minute, in the whiche the Sunne entreth into euery signe, we will followe this order.

To knowe when the Sunne entreth into euery of the xii. Signes

Upon the dayes, houres, and minutes, that the Sunne entreth into euery signe thys sayde yeere, 1545. we must adde for euery yeere fyue houres and 49. minutes, which with the 365. dayes, which euery yeere conteyneth, shalbe the tyme in the whiche the Sunne accomplysheth his Reuolution. And because that in the yeere of the Bisextile or Leape yeere, is added to Februarie one day more to his 28. which he hath once in foure yeeres, from 6. to 6. houres, yf we shall take from the computation that whyche we haue geuen hym, turning one day backward (as shalbe in the yeere 1548.) and vppon that that remayneth shall returne in the yeere folowyng. of 1549. to adde fyue houres 49. minutes, and as much more euery other yeere folowing, shalbe a certayne rule for euer.

Leape yeere.

And it is to note, that the degrees and minutes which wee haue touched before, are properly for the Citie of Cadiz. And yf we desyre to applye them for other Cities or places more Eastwarde: then for euery xv. degrees that they are distaunt from

Variation of houres by the rapte mouing of the Sunne from the East to the VVest.

Cadiz in longitude, we muſt adde one houre. And yͤ for Cities, or places more Weſtward, in like maner for euery xv. degrees we muſt take away one houre, by reaſon of the courſe of the Sun by his rapte mouing from the Eaſt to the Weſt. For it is certayne, that when with vs in Cadiz it is xii. houres of the clocke, to them that are xv. degrees Eaſtward from vs, it is one of the clock, and to them that are from vs xv. degrees toward the Weſt, it is xi. of the clocke.

Nowe that we haue Rules to knowe the entraunce of the Sunne into the xii. ſignes, thereby may we alſo knowe his entraunce into the foure Cardinall or principall ſignes, whiche are they that determine and ende the Equinoctialles and Solſtitialles, whereby are cauſed the foure tymes of the yeere. And forasmuch as the generall chaunge of tymes, is by reaſon of the Sunne, who by his comming neare, warmeth, by hys remayning, dryeth, with his departure, cooleth, and by his long tarying away, cauſeth moyſtneſſe, we will ſhewe the qualities of the principall windes, elements, regions, humours, and ages, in one briefe Table: and then conſequently in an other will we deſcribe the beginning, middeſt, and ende of the foure times of the yeere, aſwell in the monethes, as in the heauenly ſignes.

The entrance of the Sunne into the iiii. principall ſignes, cauſeth the chaunge of tyme.

The Table of the qualities of the Elementes.

Qualities.	Hot & dry	Hot & moyſt	Cold & moyſt	Cold & dry.
Partes of the yere	Sommer	Spryng.	Winter.	Autumme.
Principall windes	Eaſt.	South.	Weſt.	North.
Elements.	Fyre.	Ayre.	Water.	Earth.
Regions.	Eaſt.	South.	Weſt.	North.
4. Humours.	Choler.	Blood.	Flegme.	Melancholy
4. Ages.	Youth.	Manſkate.	Aged.	Age.

The

The Table of the foure tymes of the yeere.

Tymes.	Beginning.	Myddest.	Ende.
Spryng.	Marche. Aries.	Apryl. Taurus.	May. Gemini.
Sommer.	June. Cancer.	July. Leo.	August. Virgo.
Autumne.	Septemb. Libra.	Octob. Scorpio.	Nouemb. Sagit.
Winter.	Decemb. Capricor.	Ianua. Aquar.	Februa. Pisces.

The v. Chapter, of the Moone, and of her motions and properties.

IN the Chapters past of this seconde parte, wee haue entreated of the Sunne, and of his motions and effects, as the most noble and principall luminarie. In this present Chapter we wyll entreate of the Moone, which is the second luminarie, although in the order of the heauens she is the first, and nearest vnto vs of all other Planets or Starres.

The Sunne and Moone are the principal luminaries

The Moone therefore is a round body, of heauenly substaunce, solide and darke in respecte of the Sunne, hauing no proper light of his owne, but is apt to receyue light. She is mooued from the West into the East, according to the order of the signes, euery day 13. degrees little more or lesse, and somewhat more then 10. minutes, by the proper motion of the heauen or sphere vpon the Ares and Poles of the Zodiak. I sayd more or lesse, because that ouer and beside the mooving of her deferent or circle, which is moued euery day the aforesayd 13. degrees and 10. minutes, almost 11. she hath an Eclipse where the Moone is fixed: at the motion whereof, sometimes she is moued more swiftly, and sometimes more slowly: Neuerthelesse, according to her selfe motion, she maketh her course in 27. dayes and almost 8. houres: and hauing no light of her owne, she is lyghtened of the Sunne, as manifestly appeareth hereby, that being in coniunction with the Sunne, or neare vnto him, we see her not lyghtened: because the lyght which she then receyueth, is onely her vppermost or highest parte, whereby she directly beholdeth the Sunne, forasmuche as he is

The Eclipse of the Moone

The coniunction of the Moone with the Sunne.

The Moone receyueth her lyght of the Sunne.

in

The aspect of the Moone to the Sunne.

in the fourth heauen, and she in the first. And departing from the Sunne by her proper mouing, the Sunne remayneth on the West part. Then toward that part we begyn to see a lytle of the part of the Moone lyghtened, and so more and more by lytle and lytle, as she departeth farther from the Sunne. And at thys tyme she hath her hornes or corners towarde the East, because the Sunne is in the West. During this tyme also, she is sayde to increase, or that she goeth increasing vnto the oppolition whiche we see, by the part of her, which the Sunne directly beholdeth. And so do we see her altogeather lyghtened, and call it the full Moone. Then passyng from the oppolition, she commeth nearer the Sunne by lytle and lytle, beyng darkened and hyd from vs, and lyghtened onely by her hygheſt part: and this tyme is called the decreasing or wane of the Moone. Then also hath she her hornes toward the West, because the Sunne is in the East: and this vntyll she turne agayne in coniunction with the Sunne, and that we see her not lyghtened at all.

The increasing and oppolition of the Moone.

The bignes of the Moone.

The Moone is leſſe then the Starres or other Planets, except Mercurie, and leſſe then the earth. And yf any shall affirme the contrary, saying, that it is written in the fyrſt of Geneſis, that God made two great lyghtes: the greateſt to geue lyght to the day, and the leſſe to lyghten the nyght, (as Dauid also affirmeth.) To this I answeare, that the Moone beyng neareſt vnto the earth, appeareth vnto vs greater then she should do, yf she were further distaunt from vs. And although she be great of lyght (receyued as we haue sayde) and bigge of body, yet is she not great in respect of the other Starres. And therefore the words of Geneſis aforesayd, may be vnderſtoode to be spoken in such maner and phraſe as holy Scripture often vseth, to humble and apply it selfe to the weakeneſſe of our vnderſtanding, and groſeneſſe of our senſes.

The Moone is neareſt vnto the earth.

The

The vi. Chapter, of the conjunctions and oppositions of the Sunne and the Moone.

THE Sunne and the Moone are mooued vnder the Zodiacke with diuers motions. The Moone with a swifter motion then the Sunne soloweth hym, ouertaketh him, and goeth before him, vntill she place her selfe in Diameter with him. And when she hath thus ouertaken him, so that they are both in one selfesame degree of the Zodiacke, then is the conjunction. Then departing from him, and being in equall degrees of the signes opposite according to the Diameter, is the opposition. To knowe the times of these coniunctions and oppositions, is very profitable and necessarie for Mariners. These times may be knowen in two manners. One way, by the Ephimerides or Almanacke, or other tables, or Lunarie instrumentes. And by these meanes is knowen precisely the day, houre, and minute of the coniunction and opposition. It may likewyse be knowen by the rules of computation, whiche are the rules that are knowen by memorie, although not precisely, as by the bookes aforesayde. And heere is to be vnderstoode, that from one coniunction to another, accordyng to the halfe mooūings of the Sunne and the Moone, there passeth 29. dayes, twelue houres, and 44. minuts. And consequently from coniunction to opposition, and from opposition to coniunction, the halfe thereof, which is fourteene dayes 18. houres, and 22. minutes. To knowe these coniunctions by rules of computation, is presuppoſed to knowe the golden number, and by it, the concurrent or Epacte.

The motion of the moone.

The coniunction.

The opposite.

To know the times of oppositions and coniunctions.

The golden number, is the number of nienteene yeeres. In which time, the coniunctions of the Sunne and the Moone make all their varieties in the times of euery yeere: so that yf the conjunction were the twelfth day of Marche in this yeere of 1545. from this yeere in the nienteene yeeres folowing, which shalbe in the yeere of 1564. the coniunction shall returne to be at the twelfth day of Marche. It was fyrst called the golden number by the Egyptians, who fyrste found the vse thereof, and sent it to

To know the golden number.

Rome

Rome written in golden Letters. To fynde this number, it is needfull to know his rootes, which is this. In the yeere that Christ our Lorde and redeemer was borne (whereby we make this accompt) the golden number was the number of one, which was the yeere of the roote or beginning: and the fyrst yeere of the byrth of Christ, was two of the golden number. So that ioyning to the yeeres of our Lord one of the roote or beginning, and from all take away the nienteene, then the rest shall be the golden number. And yf you desyre to make computation by a nearer roote, take for the roote the yeere of 1500. when nienteene was the golden number, and in the yeere of 1501. did begin one of the golden number, and so consequently euer taking away the nienteene.

The rootes of the golden number.

This present yeere of 1545. we haue seuen of the golden number. And in the yeere of 1546. we shall haue eyght. &c.

The golden number being knowen, it is necessarie for thys computation of the Moone to knowe the concurrent. The concurrent of euery yeere, is the number of the dayes passed of the coniunction of the Moone at the beginning of March. And these growe of the difference of the Solar yeere to the Lunar: As the Lunar yeere hath 354. dayes, and the Solar yeere 365. so hauing euery yeere eleuen dayes of difference, which are added euery yeere vntyll they come to the number of thyrtie, and passyng thyrtie, those that do passe are of the concurrent.

The concurrent.

The Solar and Lunar yeeres.

The number of the concurrent of euery yeere, is founde in this maner.

To fynde the number of the concurrent.

And the better to beare it in memorie, you must imagine three places: and these commonly are assigned on the thumbe. As the fyrst place at the roote of the thumbe, the second in the middle ioynt thereof, and the thyrd and last, in the toppe of the thumbe. Then in the fyrst place put teme, in the second twentie, and in the thyrd thirtie. Then by the order of these places shalbe compted the golden number: As one in the fyrst place, two in the second, and three in the third, returning foure to the fyrst place. &c. vntill the golden number of that yeere for the whiche the concurrent is sought. And the number of that place where the golden number endeth, must be ioyned with the number of the golden number: and that both amount thereof, shall be the concurrent, so that it

passe

passe not 30. But if it passe 30. then that that is more then 19. is the concurrent of that yeere.

And heere is to be noted, that the yeeres of this computation of the Moone, begin at the first day of March, and last vntyll the last day of Februarie, so that this present yeere of 1545. by computation of the golden number, we haue seuen: which accompted by the sayd places, endeth in the first, which is 10. which also ioyned with the golden number of seuen, make 7. and so much is the concurrent of this present yeere.

Likewise, this number of Epacte, or concurrent, is found in Epact. multiplying the golden number by 11. & deuiding the summe by 30. then that remayneth, is the Epact or concurrent.

The concurrent being thus knowen, then to knowe the dayes of the Moone, it is necessary to knowe three numbers. The first, is the concurrent. The second, the number of the moneth in which you are, beginning at March. The third, the dayes past of the same moneth. And ioyning these three numbers, if they come not to 30. so many dayes olde is the Moone. And if they be 30. it is the coniunction. And if they passe 30. they also that passe, are the age of the Moone. To know the dayes or age of the Moone.

This is vnderstoode in the monethes that haue 31. dayes, for in them that haue onely 30. dayes, the coniunction is at the 29. day, and they that passe of 29. are the age of the Moone. As for example.

The first day of August, of the concurrent 17. of monethes from March 6. and of dayes of the moneth 1. make 24. and so much is the age of the Moone.

An other example. The tenth of September, of concurrent 17. of monethes seuen, of dayes ten, which are in all 34. And because that September hath onely 34. dayes, we must take away 29. of the 34. and so rest fiue dayes, whiche are the age of the Moone. And in lyke manner shall we geue to Februarie 29. dayes of the Moone.

He followeth, that the dayes of the Moone beeyng knowen, then vnderstanding or discrecting backewarde, wee finde for To know the day of the coniunction.

for example. The 20. of July, the Moone hath 12. dayes taken from the 20. remayneth 8. Then the eight day was the coniunction.

The day of the coniunction is lykewyse knowen by ioyning the monethes (beginning in Marche) with the concurrent, and if they come not to 30. then at so many dayes of that moneth as lacketh of 30. shalbe the coniunction.

Example.

In August 6. of the monethes, and 17. of the concurrent, are 23. which of 30. lacketh 7. Then at the seuenth day was the coniunction, and if they passe 30. then taking them that passe from the number of the dayes which the moneth had next before, and then that which remayneth, doth shew the day of the coniunction. Lyke as the Moone of September of the yeere 1546. we shall count the concurrent 28. of monethes 7. which are 35. Then taking away the 5. from 30. and one which August hath, remayneth 26. and so the 26. of August, of the yeere to come of 1546. the Moone shall make coniunction.

The vij. Chapter, of the declaration and vse of an Instrument, by the which is found the place and declination of the Sunne, with the dayes and place of the Moone.

To know the place of the Moone in the Zodiacke, and what aspectes she hath with the Sunne.

IN the seconde and thyrde Chapter, I haue geuen rules to knowe the true place of the Sunne, and his declination. In this Chapter I will describe an instrument, whereby may be knowen the declination and place of the Sunne, and knowing by the Chapter past, the dayes of the Moone, shall also bee knowen her place in the Zodiacke, and how much of her is lightened, and what aspect she hath with the Sunne.

This

This Instrument is in square fourme, and hath by the sydes 23. degrees and a halfe, of the which the 23. and a halfe that descende from the myddest downeward, is the declination of the South signes: and the other from the myddest vpwarde, are the declinations of the North signes. Within this quadrature is described a circle, by the circumference whereof, are the twelue signes and their degrees, ioyned to the circumference: and further within, is the number of them, and then their names. Yet further within this, is another circle, where are the twelue moneths, with their numbers and dayes.

The description of the Instrument.

Then to the center of this circle, are annexed two rundelles, whereof the greatest and lowest is called the rundel of the Sunne.

This hath an Inder or shewer, in which is paynted the Sun, and in the circumference of it are the dayes of the age of the Moone. In the other circle, in the circumference thereof, is a round hole, representing the Moone: directly from the which, is another Inder comming foorth of the circumference of thys rundell, in which rundell are all the aspectes which the Moone maketh with the Sunne.

Hauing described the Instrument, let vs declare the vse thereof, which is this.

Fyrst to fynde the true place of the Sunne, we must put the Inder of the rundell of the Sunne, vppon the day of the moneth in which we are, or desire to knowe the place of the Sunne. Then in the circle of the signes, it shall shew the signe and degree in the which it is: and in like maner, resting styll vpon the degree, looking in the paralels that touch in the circumference, and proceeding by that line that toucheth the Sunne which the Inder doth note, ye shall see in the syde of the Instrument, the number of the degrees of the declination which the Sunne hath at that day.

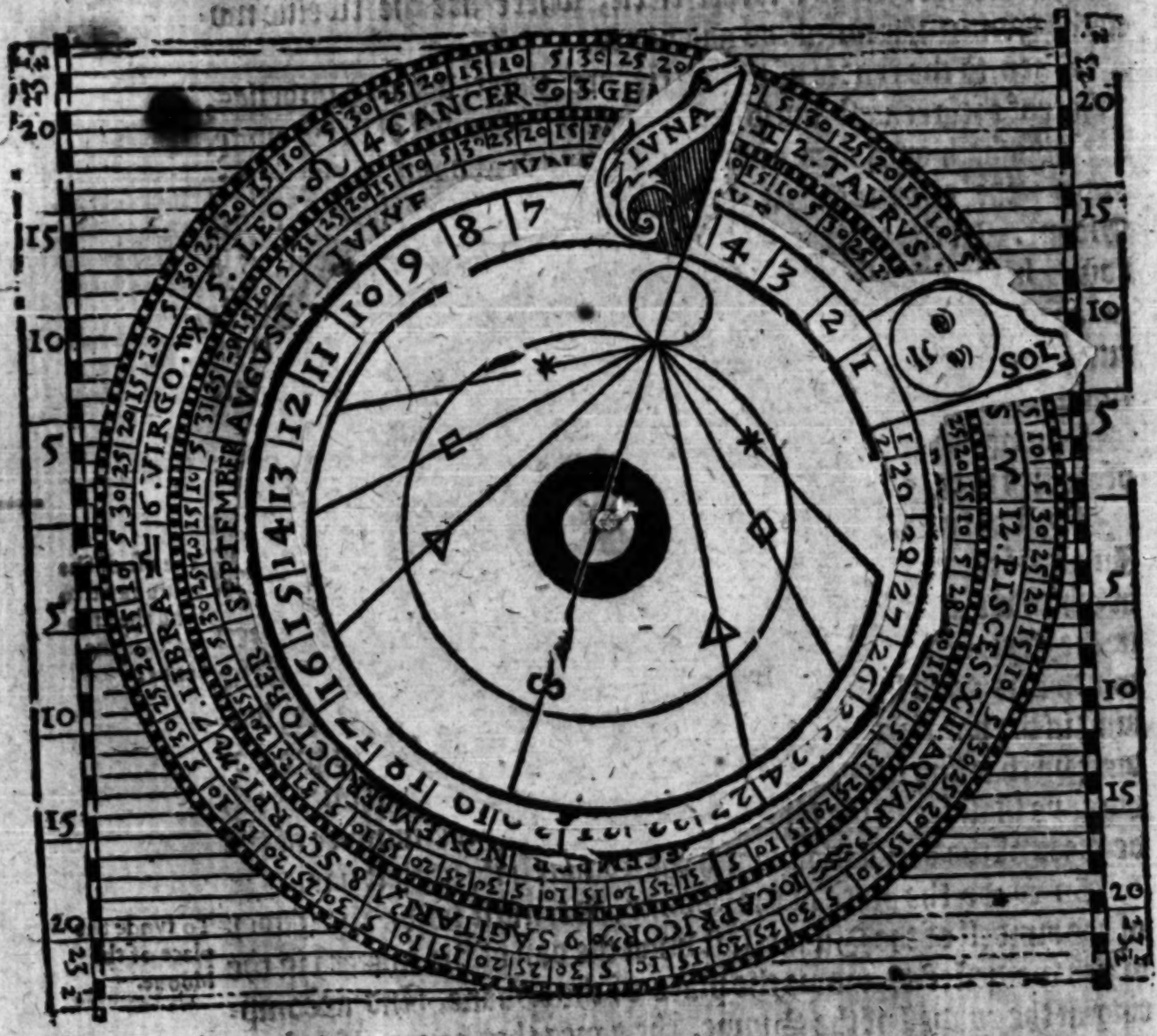
The vse of the Instrument to fynd the true place of the Sunne.

To fynde the place of the Moone, we must holde the Inder of the rundell of the Sunne, fast vpon the day of the moneth in the which we desire to knowe the place of the Moone. And accompting in the rundell of the Sunne, the dayes that haue passed from the day of the Coniunction (as I haue sayde in the Chapter before) and where endeth that number of the dayes, yf there wee

To fynde the place of the Moone.

apply

apply the index of the Moone, it shall shewe in the circle of the signes, the place where she is. And so shall she appeare in the instrument lightened, or darkened, more or lesse as in heauen. In lyke maner, consydering the place of the Sunne and the Moone, shall be seene what aspect they haue, by the lynes that trauerse the superficiall of the Lunar circle of the Moone.



The

The aſpects which the Planets haue one to another, or whereby they beholde one another, are fiue. Fiue aſpectes of the Planets.

Coniunction is, when two Planets be vnder one ſelfe ſame degree and minute in the Zodiacke, whoſe charact is this. ☌ Coniunction.

Oppoſition is, when betweene the place of the Planettes is halfe a circle, which are 180. degrees, and is thus figured. ☍ Oppoſition.

Triall aſpect is, when betweene the Planettes ſhalbe foure ſignes, which are 120. degrees, and is figured thus. △ Triall.

Quadrine aſpect is, when one Planet is diſtaunt from another by three ſignes, which are 90. degrees, whoſe charact is this. □ quadrine.

Sextile aſpect is, when two ſignes are betweene them which are threeſcore degrees, and is marked thus. ⚹ Sextile.

And yf by memorie you deſyre to knowe the true ſpace of the ſunne, without reſpect of minutes (whiche may ſufficiently be done with the Aſtrolabie) beare in memorie theſe numbers, 10. 9. 10. 11. 12. 13. 14. 13. 14. 13. 12. Of the which the firſt ſerueth for Januarie, the ſeconde for Februarie, with theyr ſignes: and ſo of the reſt. Then to knowe in what degree the ſunne is, you ſhall take away the dayes that are applyed to euery Moneth, according to the ſayd numbers of the dayes for the which you deſyre to knowe the true place of the ſunne, and in them that remayne, in ſo many degrees is the ſunne of the ſigne into the which it entreth that Moneth. And yf the dayes paſt of the Moneth, ſhalbe leſſe then the dayes applyed to the ſame Moneth: you ſhall ioyne thirtie with thoſe dayes paſt of the Moneth, and of the ſumme that amounteth, you ſhall take away the dayes applyed to the ſayd Moneth, and the reſt ſhalbe the degrees in which the ſunne ſhalbe of the ſigne of the Moneth paſt, as for example. To know the place of the Sunne by the rule of memorie. To knowe in what degree the Sunne is.

C.ii. *Example.*

Example.

Januarie.	10 ♒	The 22. of October, taking away foure-
Februarie.	9 ♓	téene that were applyed, remaine eyght de-
Marche.	10 ♈	grées of Scorpio, where the Sunne is.
Apryll.	10 ♉	*Another Example.*
May.	11 ♊	The syxe of December, whiche are lesser
June.	12 ♋	then twelue whiche is applyed vnto it, yf
July.	13 ♌	we ioyne syxe to thyrtie, whiche are the
August.	14 ♍	dayes of the moneth nextafore, they make
September.	13 ♎	36. and from them we take away the 12.
October.	14 ♏	rest 24. So in 24. degrées, is the sunne,
Nouember.	14 ♐	of the signe of the moneth before, whiche is
December.	13 ♑	Sagittarie.

The viii. Chapter, of the Eclipse of the Moone and the Sunne.

The Eclipses of the sunne and of the Moone, is a thyng that causeth great feare and admiration among the common and ignoraunt people, and to them that vnderstand the cause thereof, nothing at all. And therefore haue I thought good to declare the effectes thereof.

The Eclipse of the Moone.

The Eclipse of the Moone, is the interposition or beyng of the Earth betwéene her & the sunne. And whereas the Moone hath no proper lyght of her owne, and the earth, being darke and not transparent, maketh his shadow on the part opposite to the sunne: the Moone by her proper motion doth passe by this shadowe, and is Eclipsed or darkened eyther in the whole or in part, according to the portion of her that passeth by the shadow. Moreouer (as we haue sayde) that onely the sunne is mooued in the lyne Eclipticke, and the Earth being in the center of the world, the poynt or pricke of the shadowe shall be vnder the Eclipticke. The Moone declineth from the Eclipticke sometimes to the one part, and sometymes to the other, because her Eccentricke wherin she is mooued, doth cut the Eclipticke equally into two halfes, so that the one halfe of the Eccentricke, doth decline from the Eclipticke toward the North part, and the other

The mooung of the Sunne in the Eclipse.

halfe

halfe toward the South, and the greatest declination of it from the Ecliptike, is 5. degrées. In that maner, the Moone shalbe at no time in the Eclipticke, but only when she shalbe in eyther of the intersections where the Eccentricke doth cut the said Ecliptricke. That intersetion where she passeth & goeth toward the North part, is called the head of the Dragon, and is marked thus. ☊ The other where she passeth and declineth towarde the South part, is called the tayle of the Dragon, and is marked thus. ☋ And the Sunne moving by his proper motion, and comming to the head, then shall the shadowe of the earth be in the tayle, because it is the poynt opposite. And yf then the Moone come thyther, of her proper motion she passeth by the shadowe, and lacking lyght of the Sunne, she is eclipsed. And yf the Sunne come to the tayle, the shadowe is in the head, and then lykewise shall the Moone be eclipsed, if she passe by the head.

The head of the Dragon.

The tayle of the Dragon.

The Sunne is bigger then the earth.

The shadowe of the earth.

It is to vnderstand, that the sunne is much bigger then the earth, and by perspective, the shadowe of the earth in howe muche the farther it parteth from it, becommeth sharper and sharper, vntyl it come to a poynt: so that the shadowe of the whole earth, is pirramidally sharpe. And as the Moone is lesse then the earth, yet (although his shadowe goeth sharpning) it suffiseth to eclipse the Moone, if she passe by the

middest thereof.

The Eclipse of the Sunne.

The Eclipse of the Sunne, is the interpolition of the Moone betweene vs and the Sunne, as yf the Sunne be in the fourth heauen, and the Moone in the fyrſt, ſhe beyng a darke body, and by her proper motion ouertake the Sunne, then putting her ſelfe betweene him and vs, ſhe couereth him in part, or in the whole, and this is the Eclipſe of the Sunne. As the Sunne alſo goeth euer vnder the Ecliptykes, at that time that he commeth to the head or tayle of the Dragon, if then the Moone make coniunction with him, ſhalbe the Eclipſe of the Sunne, for as much as they are both vnder the Ecliptyke.

The Eclipſe of the Sunne is not vniuerſall.

The Eclipſe of the Sunne can not be vniuerſall in the whole earth, I ſay, vnto all them that may ſée the Sunne at the tyme of the Eclipſe, as is the Eclipſe of the Moone vniuerſall. For yf the Moone haue one part Eclipſed, all that may ſée her, ſhall ſée her Eclipſed: But the Sunne ſome may ſée al wholly Eclipſed, and other in part, or other alſo not at all Eclipſed: and this all at one ſelfe ſame time. The cauſe whereof, is the diuerſitie of the aſpecte, which is, to ſée the Moone in the Zodiacke out of her place: as yf the Sunne and Moone ſhould make coniunction in the beginning of Aries, and in the head of the Dragon, they that then ſhould be in the Equinoctial, vnder the Sunne and the Moone, or that the Sunne and the Moone ſhould be in theyr Zenith, they ſhould ſée the Moone hyde all the Sunne.

How the Sunne is eclipſed in the whole, or in part.

And they that ſhould be in the North Climates, ſhould ſée, that the Moone hydeth or darkeneth onely the South part of the Sunne, and not al. Againe, they on the South part, ſhould ſée the Moone hyde the North part of the Sunne, and not all. And yf at the tyme of the coniunction, ſhe haue a lytle paſſed the head of the Dragon, or lacke a lytle to come to the tayle, ſo that ſhe be in the North latitude: they that then ſhould be in the North Climates, ſhoulde ſée the Moone Eclipſe all the Sunne: and they of the Equinoctiall ſhoulde ſée onely the North parte of the Sunne Eclipſed, and they of the South ſhoulde ſee hym nothyng at all Eclipſed. So that although

although the Eclipse of the Sunne shalbe totall or perticuler, it can not be vniuersall in the whole earth.

And note, that for the quantitie of these Eclipses, the Astronomers deuide into twelue equal partes, aswel the Diameter of the Sunne, as of the Moone, and these partes they call figures, punctes, or prickes, and according to the punctes of the Diameter of the Moone, whiche is couered by the shadowe of the earth, or the partes of the Diameter of the Sunne, whiche the Moone doth couer, so many fingers or punctes shalbe sayd to be Eclipsed. As yf 6. the halfe, yf 3. a quarter, yf 4. a terce, or thyrde parte, yf 6. thrée quarters, yf 8. two terces.

Of the quantitie of the Eclipses.

It is also to be noted, that although the Sunne be bigger then the Moone, yet at sometyme the Moone seemeth greater then the Sunne. And thys shall bée, when the Sunne is in the Auge of the Eccentrike, and the Moone in the opposite of the Auge of the Epicicle.

why the Moone seemeth somtime bigger, and sometime lesse then the Sunne.

And when it so appeareth, he may be all Eclipsed. Sometymes also the Moone seemeth lesse. This is when the Sunne is in the opposite of the Auge of the Eccentricke, and the Moone in the Auge of the Epicicle. Then although we shoulde sée the center of the Moone in the center of the Sunne, she can not hyde hym all wholye, because the Sunne shall appeare greater.

Of this that we haue sayd, it followeth that all the Eclipses of the Sunne, must of necessitie be in the coniunction, and the Eclipses of the Moone, in the opposition: whereby is inferred, that the Eclipse of the Sunne in

The Sunne is Eclipsed in coniunction, & the Moone in opposition.

The Eclipse of the Sunne in the death of Christ.

the death of Christ our redéemer, was not naturall, but miraculous: forasmuche as then was xv. dayes of the Moone, at whiche tyme the Moone is at the full, and farre distant from the Sunne, and could not Eclipse hym. In lyke maner is to bee noted, that to see the Eclipses, they of the Sunne must be in the day, and they of the Moone in the nyght. And whether the coniunction be in the nyght, or the oppositon in the day, the Astronomers make none accompt.

how to see the Eclipses.

¶ The ix. Chapter, of tyme, and of the definitions thereof.

All mouing is in tyme.

FOrasmuch as hytherto we haue entreated of the mouings of the Sunne and of the Moone, and how all mouing is in time (for that nothing may be moued in any instant or out of tyme) it shalbe conuenient nowe to declare what thyng Tyme is, and into what partes it is deuided.

what is time.

Tyme (as sayth the Philosopher) is a measure of mooving, according to fyrst and last, or before and after. Although by accident (as Armandus hath subtilly defined) Tyme may be a measure of rest or quietnesse: as measures of habites, are measures of priuations. Or Tyme may be a measure of the mouing of the fyrst moueable, called Primum mobile, and cause of generation thereby, and of corruption by accident. Tyme hath the limittes that hath the worlde, and as the worlde, so is it the cause of the mooving of the heauens, and beganne when God created the heauens, and shall ende when the worlde shall haue an ende, as the holy Scholes of the Diuines teache vs. It is assigned to be within the heauens, forasmuche as without them, is neyther tyme nor any naturall place. All the tyme since God created the worlde, vntyll it shall haue an ende, is called Seculum, (that is) a worlde, or an age of Tyme. Albeit, this word

how time is cause of generation and corruption.

The beginning and ending of tyme.

The space of tyme.

Seculum

Seculum in an other sense, may be extended farther then the durabilitie or continuaunce of the world, and this in holy Scripture is called Seculum seculi, that is, The world of the world: or Secula seculorum, whiche is as much to meane, as, The world and worlds to come, which signifieth, eternitie, or euerlasting worlde without end. Lykewyse also, Seculum is taken for the space of a hundred yéres, whereby in olde time certayne playes were called Seculares, because they were celebrate from a hundred, to a hundred yéres. The Pope Paule, the third of that name, commaunded them to be celebrate in Rome, in the yére of 1536. which was the yére in the which the Seculum ended, and began a new Seculum.

And as in tyme are dyuers mouings, so hath it diuers measures, whereof some are greater, and other lesse. The greatest measure of tyme, is a reuolution of the heauens, which is slowly mooued, and the principall or chiefe of these, is that that the Suane maketh, which we call a yére. The lesse measure, is the mooning of the fyrst mooueable, which mooueth most swiftly: and this measure we call a day. And for as much as there is variation in the greatest measures, we will in the Chapter following, intreate of the yére, and of the diuersitie thereof. Diuers mouinges and measures of tyme.

The x. Chapter, of the yeere, and of the diuers beginnings and reckonings, or computation had thereof in olde tyme.

THere are three differences of the yére, as the great yére, called Annus magnus, the solar yére, and the Lunar yére. Three differences of yeeres.

The great yére, is the space of tyme in the which all the Planets returne to the place where they had béen sometime before. As if they all had béen in the beginning of Aries, & had begun their course from thence, and should againe all returne thyther: then should be the great yére. The great yeere.

The reuolution of the eight Sphere.

By the description of other, the great yere is when the eight sphere toyntly with all the Auges, make one perfect reuolution at the mouing of the nynenth Sphere. And this shall be in the space of xlix. thousand yeres.

The Solar yeere.

The solar yere, is a reuolution of the Sunne, carried by the proper mouing of his heauen vppon the Axis and Poles of the Zodiacke, ending where it began, and returnyng an other yere by the selfe same course, as the Poet Virgil affyrmeth, saying.

Atque in se sua per vestigia volvitur annus.

That is to say, The yere turneth agayne to hym selfe by his owne proper steppes.

how the Egyptians painted the yeere.

The Egyptians lackyng the vse of Letters, and haupng the same consideration, paynted the yere lyke vnto an Adder, bytyng her owne tayle: and hereof was a ryng called Annulus, as it were Annus (that is, a yere) because a ryng turneth round in it selfe, as doth the yere.

The quantitie of the yeere.

Of the quantitie of this yere were diuers opinions and computations among them of auncient tyme. The Arabians and Persians accompted it regularly by xii. Monthes, which are 354. dayes. Romulus gaue to his yere x. monethes, because that tyme sufficeth to a woman to bryng forth her byrth, and also for that durying so much tyme, it was not lawfull for a Widdow to marrie after the death of her husbande. Numa Pompilius added two monethes, to make it vp

The yeere of the hebrues.

twelue monethes in 350. dayes, whiche was the most auncient yere of the Hebrues, accordyng to the which, they accompt at

The Greekes.

this day. The Grekes and Egyptians, conspyering the course of the Sunne, made the yere of 365. dayes. Then by the com-

Iulius Caesar.

maundement of Julius Caesar (whose order we now obserue) were added syxe houres, to the ende to make equall this number of dayes with the course of the Sunne: and hereof the Bisextile

Leape yeere.

or Leape yere had his beginning, from foure to foure yeres. But to say the trueth, they erred: The one, by somewhat too much, and the other by somewhat too litle.

Dayes of the yeere.

This yere conteyneth 365. dayes. 5. houres, & 49. minutes.

Lyke-

Lykewyse at the fyrst, the yéere had diuers begynninges. Numa Pompilius began it from the Winter solsticiall, because that then the Sunne beginneth to rise toward vs, as Ouid affirmeth in these verses: Beginning of the yeere. Ouid.

Bruma noui prima est, veterisque nouissima Solis.
Principium capiunt Phœbus & Annus idem.

bruma is the stay of the sunne in winter, the winter solstitiall, and shortest day of the yeere.

Which may thus be englyshed.

Bzume is the fyrst of the newe yéere,
And last day of the olde:
The Sunne and yéere beginne at once,
As Ouid hath vs tolde.

Romulus began it at Marche, at the Equinox of the spring, because that then all thyngs reuiue and flowrythe: and by the opinion of the Diuines, it séemeth good reason to begyn the yéere at Marche, because the world was created the 25. of the Kalendes of Apryl, which is the 18. of the moneth aforesayde. Lykewyse, God speaking of this moneth to the people of Israel, sayd vnto them, This shalbe the fyrst of the monethes of the yéere. The Arabians begin from the Sommer solstitiall, whose opinion is, that the Sunne was made in the signe of Leo. Other begin the yere in September, about the Equinoctial of Autumne, as do the Iewes, resting in the authoritie of Genesis, where it is wrytten thus: Let the earth bryng forth gréene hearbes, to haue fruite agréeable to theyr kynde. &c. And because Autumne is a fruitefull tyme, they beganne from thence to accompt their yéere. The Grékes, Persians, and Egyptians, accompt it from October. The Christians, some from the Incarnation of Christe, other from his byrth, and other from the fyrst daye of Januarie. The Creation of the world. Exod. xii. VVhere the Christians begin the yeere.

In lyke maner, is great diuersitie in beginning the number of yéres, whiche we call Era, that is, the date. The Grékes beganne their date, from the death of great Alexander. The Egyptians, from the death of Nabuchodonosor. The Persians, Diuersitie in the number of the yeeres or the date.

Machomet.

slaues, from Geldargit. The Arabians or Moores, from the preaching of Machomet, who was after the byrth of Christ 626. yeres. Other also from the Romane Emperours. The Christians began the accompt of our Sauiour Iesu Christ 500. yeres after his byrth, as writeth Cardinal Cusanus. And here it shall not be from my purpose, to shewe how iustly and ryghtfully was commaunded by Don Iohn King of Spayne, the fyrst of that name, that in the Courtes and Parliamentes whiche he helde in Segouia, in the yere of 1383. leauing the dates that they had begun from the Emperour Octauian, for tributes and other payments specifyed in Wrytynges and Priuileges, they should no more put the date of the Emperour, for as much as the day in the which the Sonne of God became man, and was borne by the blessed Uirgin, was so excellent a thyng, and most worthie to be had in memorie. So that in Spayne, since that tyme, in all common Writyngs, the date is made from the Natiuitie of our Lorde, begynnyng there the fyrst day of the yere, and commonly the fyrst day of January. Some Astronomers begyn it the fyrst of Marche.

The date of the Christians

We haue in this Chapter entreated of the great yere, and of the Solar yere, with his quantitie, beginning, and date. In the Chapter folowyng, we wyll entreate of the Lunar yere, which we call a moneth.

¶ The xi. Chapter, of the moneth, and of his differences.

The Lunar yeere, or moneth. Reuolution of the moone.

Consydering the moneth absolutelye, without hauing respecte to the Solar yere, it may be called a yere, according to the diuision we haue made in the Chapter of the yere. For it is a reuolution of the heauen of the Moone which moueth slowly in compartson of the fyrst heauen. And yf we consyder the moneth

neth as part of the yeere, then is the name of a moneth more proper vnto it. For this word Mens menſis, in Latin, is derined of Menſura, which ſignifieth meaſure. And ſo the moneth and yeere referred to tyme, all may be called moneth: forasmuch as all is the meaſure of tyme, as we haue touched in the layd Chapter of the yeere.

The moneth is to be conſydered in two maners: eyther (as it is) part of the Solar yeere, or is cauſed by the courſe of the Moone. The moneth that is part of the Solar yeere, is that which at this day we vſe. And into xii. of theſe monethes, is the yeere diuided: as Januarie, Februarie, Marche, Aprill, May, June, July, Auguſt, September, October, Nouember, December. The deuiſion of the yeere into twelue monethes.

They are not all of equall dayes, Aprill, June, September, and Nouember, haue 30. dayes: all the other haue 31. except Februarie, which hath 28. and when the Biſextile or Leape is, it hath 29. The names and numbers of theſe monethes were aſſigned at the wyll and pleaſure of men, and the cauſe why they haue remayned ſo long time, is the authoritie of the Emperours, that ordeined them for the common people, who accepted them by the Romane Church, which admitted the vſe of them.

The Lunar moneth hath two conſyderations. The one is the tyme whiche the Moone tarieth from that ſhe commeth forth from one poynt of the Zodiacke, vntyll ſhe returne thyther by her proper mouing, and this is called the moneth of the peragration, in which reuolution ſhe ſpendeth 27. dayes, and almoſt 8. houres. The other conſyderation is, hauyng reſpect to the tyme whiche the Moone taryeth, from that ſhe is in coniunction with the Sunne, vntyll another coniunction. And this is called the moneth of Conſecution, and is more then the moneth of Peragration, by two dayes 4. houres. 44. minutes. For the Sunne and the Moone beyng in coniunction vnder one punct of the Zodiacke, and mouing both by theyr proper moouinges, towarde the Eaſt, as the mooupng of the Moone is ſwifter then the mooning of the Sunne, ſhe leaueth hym behynde. The Lunar moneth. The moneth of peragration. The moneth of conſecution. The mouing of the Sunne and moone in coniunction.

And

And when she hath ended her moneth of peregrination, she returneth to the poynt from whence she departed, and not findyng the Sunne there (because in the meane tyme the Sunne of hys proper motion hath gone almost 27. degrées) the Moone passeth from this poynt, and in the sayde 2. dayes. 4. houres 44. minutes, ouertaketh the Sunne: and so commonly hath this moneth of consecution 26. dayes. 12. houres, and 44. minutes. So that whatsoeuer is sayd of the Lunar moneth, is to be vnderstood of this moneth of consecution, whiche all they vse that accompt by Moones: as dyd the Hebrues, Arabians, and Persians.

To know the tydes by the aspectes of the Moone.

The Mariners ought not to neclect this computation, because it is conuenient for them to knowe the tydes, and other effectes caused by the aspectes of the Sunne and the Moone, for their aspectes do correspond to the partes of this moneth, as the coniunction to the beginning, the oppositiõ to the middest, and the quartile aspect to the quarter, and so of the other. Lykewise in this moneth, is considered the illumination of the Moone, and the dayes that the lyght fayleth her: so that neyther by day nor by nyght wée may sée her, for beyng burnt vnder the beames of the Sunne. The tyme that shée is so, is called Interlunium (that is) the chaunge or hydyng, whyche is sometyme more, and sometyme lesse. When the coniunction shalbe from the beginning of Capricorne vntyll the ende of Gemini, and the Moone hath North latitude, and her mouing swyfte: then shall the newe Moone soone be séene, and so shall the Interlunium be but lytle. And when the coniunction shalbe from the beginning of Cancer, vntyll the ende of Sagittarius, and the Moone hath South latitude, and her mouing slowe, the longer will it be or the new Moone shew her selfe to vs: and certaine of the causes concurring, and not all, so shall the Interlunium be in a meane betweéne both.

The illumination or change of the Moone.

Interlunium, is the space of tyme in the which neither the old Moone doth appeare, nor the newe Moone is seene.

(*.*)

The

The xii. Chapter. Of the weeke.

THe weeke is a tyme of seuen dayes, the beginning whereof is Sunday, and so did the Iewes count their first day, saying, Prima Sabati, secunda Sabati, (that is) the first of the Sabboth, the seconde of the Sabboth. &c. to the sixth of the Sabboth, and then the Sabboth. The Romanes that called the Planets Gods, forasmuch as the sunne was principall among them, called their first day, the day of the sunne, the seconde, of the Moone, the thyrde, of Mars, the fourth, of Mercury, the fyfth, of Iupiter, the syxth, of Uenus, the seuenth, of Saturne. The Christians solemnising the sunday, began their accompt from it: as, on such a day our Lorde was borne: on such a day he rose: and on such a day he sent the holy Ghost vpon hys Apostles. &c. They also accompt the dayes of the weeke for Ferias.

The weeke of the Iewes.

The Romanes.

The Christians.

Ferine, signifieth vacant daies, or sometime holy or festiuall dayes.

The xiii. Chapter, of the day, and of the nyght.

THe daye is of two sortes, as, the naturall day, and the artificiall day. The naturall day, is the space of tyme, wherein the sunne is caryed by the first moueable about the earth, from the Meridian, to the West, and from the West vnder the earth, comming to the East, and from thence returning againe to the sayde Meridian: and this time hath the Equinoctiall geuen one whole turne, and more, suche parte of it as correspondeth to the proper moeuing of the sunne: or otherwise, the naturall day is a circle described with the center of the sunne, at the moeuing of the first moueable. The Romanes began this naturall day, from midnight, and ended it in the mydnight folowing, and so do we accompt

The naturall day.

The beginning of the naturall day.

compt it for fasting dayes: and from euening to euening, in celebrating of festiuall dayes. The Athenienses began it at the Sunne set, or going downe of the Sunne. The Babylonians, at the rising of the Sunne. The Umbrians, and Ethuscos, from the myddy, or noone, and ended it the noone day following. In this manner do the Astronomers begyn it, and fynde that the day shall euer begyn at one selfe same houre for the qualitie of the Meridians. And yf they had begun it from the rising or fall of the Sunne, it should not be euer at one selfe same houre, because the Sunne riseth and falleth at sometymes sooner, and at other times later: and so should the beginning of the day be variable. And it is to vnderstand, that when we commonly say, at the tenth day of such a moneth: the same tenth day doth ende the same day at noone, and the houres that runne from that noonetyde forward, are of the eleuenth day: and so do the Astronomers accompt them.

The ende of the naturall day.

The artificiall day.

The nyght.

The day artificiall, is part of the day natural, and is the tyme that the Sunne tarieth from that it riseth in the East, vntyll it fall in the West, And the nyght is that part that lacketh or tayleth for the naturall day, which is the time that the Sunne taryeth from that he hydeth hym selfe in the West, vntyl he returne to appeare in the East: and so the day artificiall and the nyght, make one naturall day. And accordyng hereunto, it is written in Genesis, that of euening and morning was made one day. Isodorus defining this artificiall day, sayth, that the day is the presence of the Sunne, or the beyng of the Sunne aboue the earth: as it is nyght vnto vs when he is vnder it. Or otherwise, the night is the shadowe of the earth, extended diametrally opposite to the Sunne. The quantitie and differences of these dayes artificiall, and theyr nyghtes, and how they increase and diminishe, we haue largely declared in the fyrst Chapter.

The

The xiii. Chapter of houres.

There is two differences of the day, as the naturall day, and artificiall: so is there two differences of houres, as houres naturall, which correspond to the naturall day, and houres artificiall which correspond to the artificiall day. houres natural and artificiall.

Hora or Ora is a Greeke name, and signifieth ende. And so say we Ora maris, for the ende or brymme of the sea, or the list or edge of apparell, as sayth Isodore in his Etimologies. The houre natural or equal, is a 24. part of the day natural, and is the time of passing fyftene degrees of the Equinoctial. The hour natural or equal. These 24. houres that make one naturall day, the Astronomers doth begin the day at the Meridian, compting the houres after the order of the fyrst moueable, which is from the sayde Meridian, in the angle of mydnyght, where they accompt twelue houres, and from thence toward the East, and come to ende the 24. houres in the same Meridian where they began: and this they vse for the computation of the tables of the mouings of the heauens. The Astronomers vse the same in theyr instruments, as in the Astrolabie, and Dials Horizontall, and verticall, and in all other instruments for houres. In Spayne also we vse to accompt these 24. in two tymes twelue, begynning at noone, and ending twelue at mydnight: and agayne, beginning at mydnight, and ending other twelue at noone. And to distinct the one from the other, they call the one afternoone houres, and the other forenoone houres: and commonly we say fyue houres of the morning, and fyue of the euening. In Italie they accompt them from the falling of the Sunne, vntyll the next fall the day folowing.

The artificial or temperal houre, is a twelfe part of the day arcke, or the nyght arcke. The houre artificial or temperal.

They

They are called temporall houres, because they varie in the tymes that the day varieth: For in the time that the dayes shall be great, so shalbe the houres: and when the dayes shalbe short, so lykewise shall the houres be, and in lyke maner of the nightes. So that, as the artificiall day, great or lytle, is deuided into twelue houres: euen so the nyght great or little, is deuided into other twelue. The auncients deuide the day into foure partes, and the nyght into other foure, geuing vnto euery quarter part three houres. At the ryssyng of the Sunne, which was the fyrst houre of the fyrst quarter, they called the fyrst houre: and three houres passed, they called the thyrd houre, and syxe houres passed of the day, they called the syxth houre, which was the midday or noone tyde. Also the nienth houre, they named at niene houres past of the day. And the Sunne set, or goyng downe of the Sunne, they called the Euening: as sayth the Poet Virgil in this verse.

The day and nyght diuided into foure partes.

Ante diem clausam componet vesper olimpo.

And accordyng to this computation, is to be vnderstoode that wryteth Saint Matthewe: That the labourers came to the Vineyarde at the eleuenth houre, whereby is meant the fyfth houre, one houre before the Sunne was set. And when we reade in S. Iohn: The ague left hym the seuenth houre. &c. By this accompt it was one houre after noone, when Christ healed the sonne of the Ruler that was diseased in Capernaum. In lyke maner by these houres, the auncients deuided the nyght into foure quarters, geuing three houres to euery quarter. And in these foure partes of the nyght were Souldiers appointed to watche. In the fyrst quarter, whiche they call Canticinium, (and we the fyrst slæpe) they watched all. In the second, which they called Intempestiuum, being the turne of midnyght, the young men watched. In the thyrd, which they called Gallicinium, of the crowing of Cockes, watched the Souldiers of middle age. In the fourth and last quarter, called Matutinum, or Antilucanum (that is, the spring of the day) the old Souldiers watched. And thus is vnderstood the fyrst, the seconde, and thyrde watche,

Interpretation of certayne places of the Gospell.

The night diuided into iiii. quarters. Four watches of the nyght.

watch of the nyght, in lyke maner ought the Mariners to kepe watch and warde, to anoyde aswell the perill of the sea, as also the daungers of Rouers: and to deuide the nyght by quarters, after the maner of Souldiers, as dyd also the Mariners in olde tyme.

how Mariners ought to watch.

The xv. Chapter, of the making and vse of an vniuersall Dyal for the day.

Whereas in the Chapter before, we haue intreated of houres, and theyr differences, we entend here to describe the making of an Instrument general, to know the houres of the day by the beames of the Sunne, which is done in this maner. Take a round plate of Laton, and let it be called the Equinoctiall circle, the circumference whereof, you shall deuide into 24. equall partes by both the sydes, and from the center to euery of these partes, you shall drawe a right lyne: one of the which shalbe a Meridian. And in the one part of that, write twelue, whiche shall be the houre of the mydday or Noone. And in the other part write other twelue, which shall be for Mydnyght. In the highest part, turnyng vpon the center, towarde the ryght hande, write one, two, three, foure. &c. In the lower, or neather part, you shall count towarde the left hande, turnyng it vppon the center: so that the one houre of the one parte, come vppon the lyne of the one houre of the other parte, in lyke maner two vppon two, three vppon three, and so forth of the other. And note that in the lyne of syxe at after Noone, and at the lyne of syxe in the Morning, there remayne certayne rounde peeces, corners, or endes, after the maner of Axis, of the thicknesse of the selfe same plate. Then make a halfe circle of the same mettall, as bygge as the halfe circumference of the plate, and of the thicknesse of a peece of foure ryalles of Plate, or somewhat more, euen as the plate it selfe, and of the breadth of halfe a

To know the houres of the day by the Sunne.

synger, if the instrument shalbe great: or lesse, if the instrument shalbe lesse. This halfe circle, shall you graduate or diuide into 180. degrées, beginning at the one ende, one, two, thrée, and so forth, vnto 90. in the myddest, and the lyke shall you doo from the other ende vnto the same 90. Also, you must number them in the breadth of the same halfe circle: and this halfe circle, shall you make fast on the neather part of the instrument, so that the endes thereof may be fixed in the endes of the Meridian line. Then through the center of the plate or Equinoctiall circle, shal passe a rounde stéele or wyre of the same mettall, made fast or sodered in it, so that it rise and come forth equally from euery side of the plate the fourth part of the Diameter of the same, and this shalbe called the Axis or exiltrée of the world. The instrument being thus made, you shall place it, or set it in a frame, hauing two armes, standards, or arches, so that it change betwéene the sayd arches, borne vp by the ronnde pæces or endes of the plate, left therof at the endes of the line of the syxe houres aforesayd, in such sort, that being thus stayed, it may be directly turned. And in the middest betwéene these two armes, beneath in the foote of them, or where they are placed, you shal rayse a prick, or poynt: so that the plate which signifieth the Equinoctial, being perpendiculer, the brimme or edge thereof may fall vpon the poynt or pricke, and consequently the plate standing playne or flatte, the nientie degrées of the halfe circle, must shew or touche the sayde prick, as shal also the end or extremitie of the Axis of the world, and the other ende shall shewe the Zenith or vertical poynt.

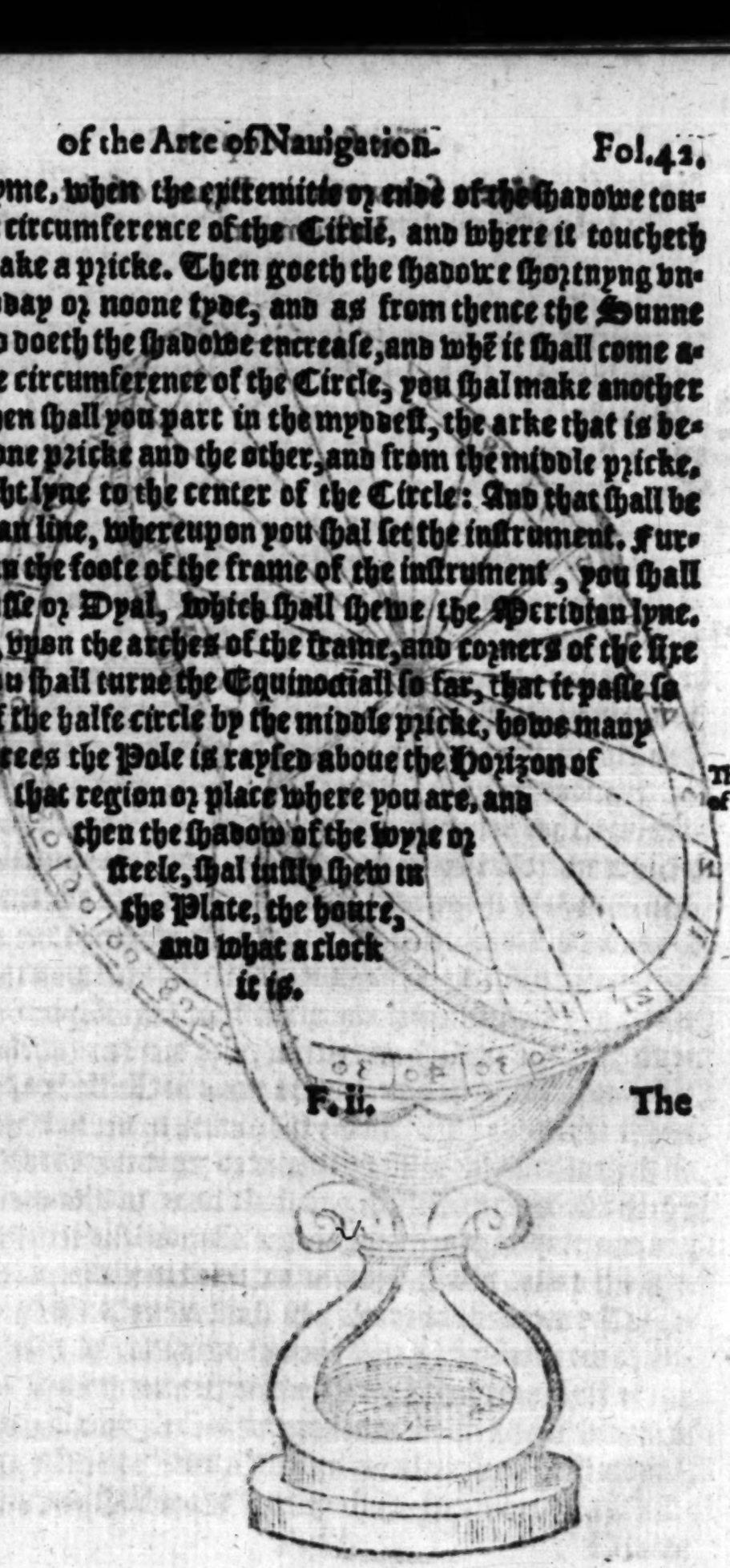
The placing of the instrument.

This instrument must be so placed, that the Meridian line be North and South: which you shall finde in this maner. In an open and playne place, where the Sunne shyneth for the most part of the day, you shall make a circle with a payre of compasses, in the middes whereof, you shall set a stéele or wyre, so vpright, that it declyne not, or bend not, eyther one way or other, and the same no longer then the fourth part of the Diameter of the circle. Then in the morning when the Sunne ryseth, the shadowe shall be very long, and as it ryseth hygher and hygher, so the shadowe waxeth shorter and shorter. Then must you obserue

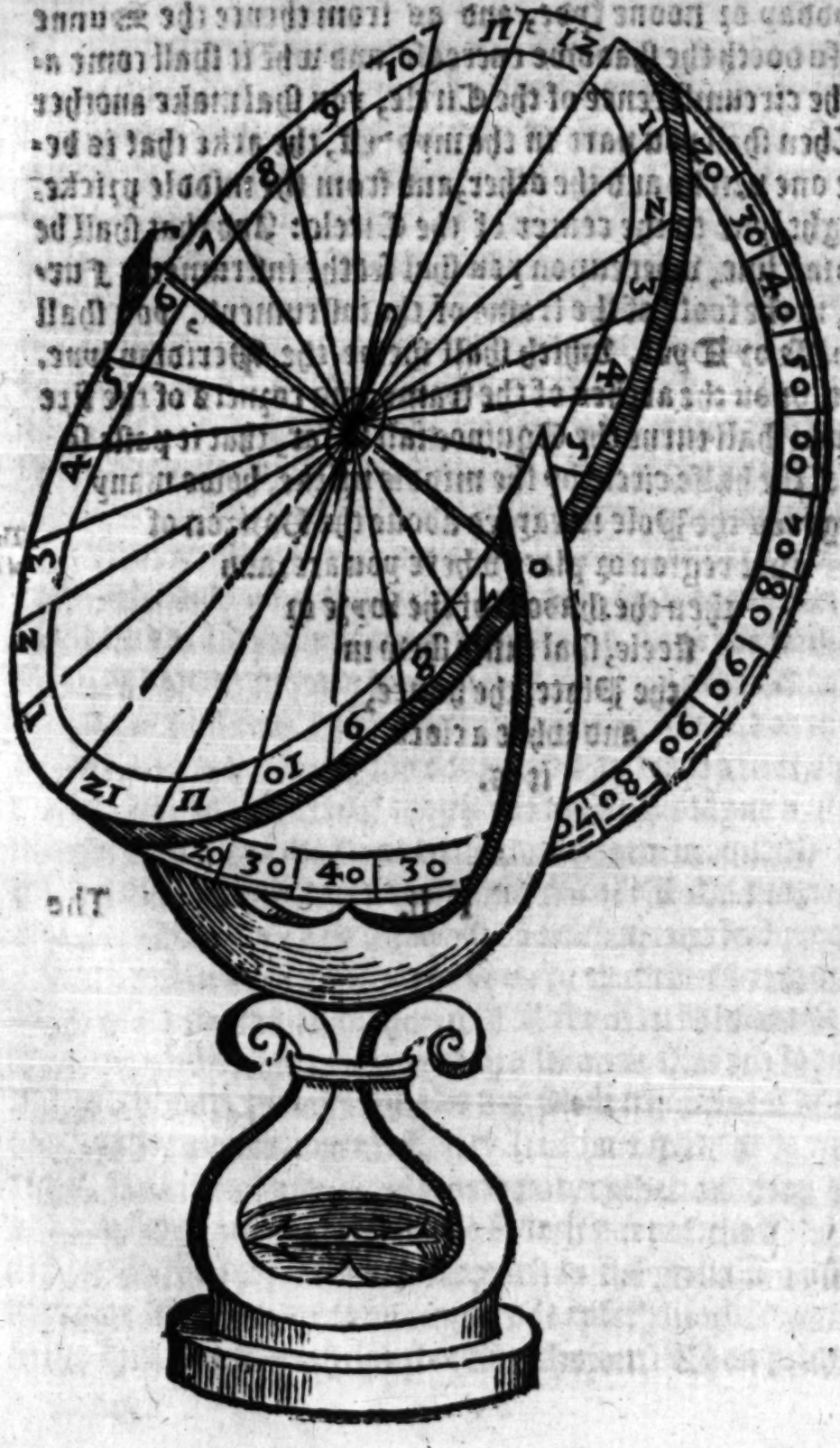
The fynding of the Meridian lyne.

ſerue the tyme, when the extremitie or ende of the ſhadowe toucheth in the circumference of the Circle, and where it toucheth you ſhall make a pricke. Then goeth the ſhadowe ſhortnyng vnto the myddaye or noone tyde, and as from thence the Sunne declineth, ſo doeth the ſhadowe encreaſe, and whē it ſhall come againe to the circumference of the Circle, you ſhal make another pricke. Then ſhall you part in the myddeſt, the arke that is betweene the one pricke and the other, and from the middle pricke, drawe a ryght lyne to the center of the Circle: And that ſhall be the Meridian line, whereupon you ſhal ſet the inſtrument. Furthermore, in the foote of the frame of the inſtrument, you ſhall ſet a compaſſe or Dyal, which ſhall ſhewe the Meridian lyne. This done, vpon the arches of the fraime, and corners of the fyre houres, you ſhall turne the Equinoctiall ſo far, that it paſſe ſo much of the halfe circle by the middle pricke, howe many degrees the Pole is rayſed aboue the Horizon of that region or place where you are, and then the ſhadow of the wyre or ſteele, ſhal iuſtly ſhew in the Plate, the houre, and what a clock it is.

The elevation of the Pole.



Heere foloweth the Figure of the Instrumeht.



The xv. Chapter, of certayne particuler Dyals, Mural, and Horizontall.

AMong sundry manner and fashions of perticuler Dyals, there are two principall. Whereof the one is Horizontall, which is placed in the superficiall of the Horizon: the other is verticiall, and must be made or set on a wall perpendiculer, and directly against the South or myddy, from the true leuant or East, to the true ponent or West, the whiche the Mariners call East & West. To make any of these two Dials, you must drawe a right lyne, and call it the Axis of the poles of the world, vpon the which you shall drawe an halfe circle, and deuide it in 90. equall partes. And where the halfe circle is cut with the lyne of the Axis, must be accompted by the circumference, the altitude of the pole for the citie or place for the whiche you intende to make the Dyall. And in the poynt of the circumference where endeth the altitude of the pole, you shall make a marke, and write there, The altitude of the pole. And from that poynt draw a ryght lyne vnto the poynt where you began to accompt the altitude of the pole, which lyne shalbe called the Semidiameter, or halfe Diameter of the verticall circle. And from the same poynt of the altitude of the pole, drawe another ryght lyne to the other extremitie or ende of the Axis, and this shall be called the Semidiameter of the Horizon: and likewyse from the same poynt of the altitude of the pole, draw a ryght lyne perpendiculer vntyl it touche in the Axis, and this shalbe called the Semidiameter of the Equinoctial. Hereby is conspyered a Triangle, which hath by the sydes thereof the Semidiameter of the vertical, the Semidiameter of the Horizon, and the Axis of the worlde, which Triangle shal serue afterwarde. These thre Semidiameters, of the vertical, the Equinoctiall, and the Horizon, being founde, you shall make the Dyall in this manner.

Dyals horizontall and verticall.

East & VVest.

The Triangle.

The making of the Dyall.

Drawe a ryght lyne somewhat long, and call it the lyne of contingence. This shall you cut with an other lyne in ryght angles, after the maner of a crosse, whiche shalbe the Meridian lyne. Then with your compasse, take from the Triangle the Semidiameter of the Equinoctiall, and of this bygnesse drawe a circle vpon the Meridian lyne: so that the edge or bymme of the circle, touche in the lyne of contingence. Then with a compasse, take the Diameter of the verticall circle, yf you will make a murall Dyall, or the Semidiameter of the Horizon, yf you will make a Horizontall Dyall, on a playne or flatte fourme. Therefore with such Semidiameter as you desyre, you shall drawe a circle vpon the other part of the Meridian lyne, so that the circumference thereof touche in the lyne of contingence. Then shall you deuide the Equinoctiall circle into foure equall partes, and the quarter that is towarde the lyne of contingence, shall you deuide into syxe equal partes. And settyng the ende of the ruler in the center of the Equinoctial, and vpon euery poynt of them that deuide the syxe equal partes, from thence shall you drawe certayne ryght lynes, vntyll they touche in the lyne of contingence. And from these poyntes of the line of contingence, you shal draw other ryght lynes, to the center of the Horizontal circle, which lynes shalbe the determiners of the houres. And nere vnto the Meridian lyne, where it toucheth in the lyne of contingence, you shal wryte twelue, and consequently towarde the East, you shal wryte one, two, three, foure, fyue, syxe: and from the syxth houre, you shal drawe a ryght lyne, which shall passe by the center of the Horizontal circle equally distant from the lyne of contyngence. The one quarter of the Horizontal beyng drawne by the selfe same, and of the same measure and bygnesse shal you drawe the other, in suche sorte, that the same bygnesse that is from twelue to one, the selfe same shall you geue from the twelfth, to the eleuenth: and the same bignesse and measure that is from one to two, shal you geue from eleuen to twelue, and so forth of the other.

Any note that the Horizontal Dyall, after the syxth houre of the euenyng, shall haue the houres of seuen and eyght, and

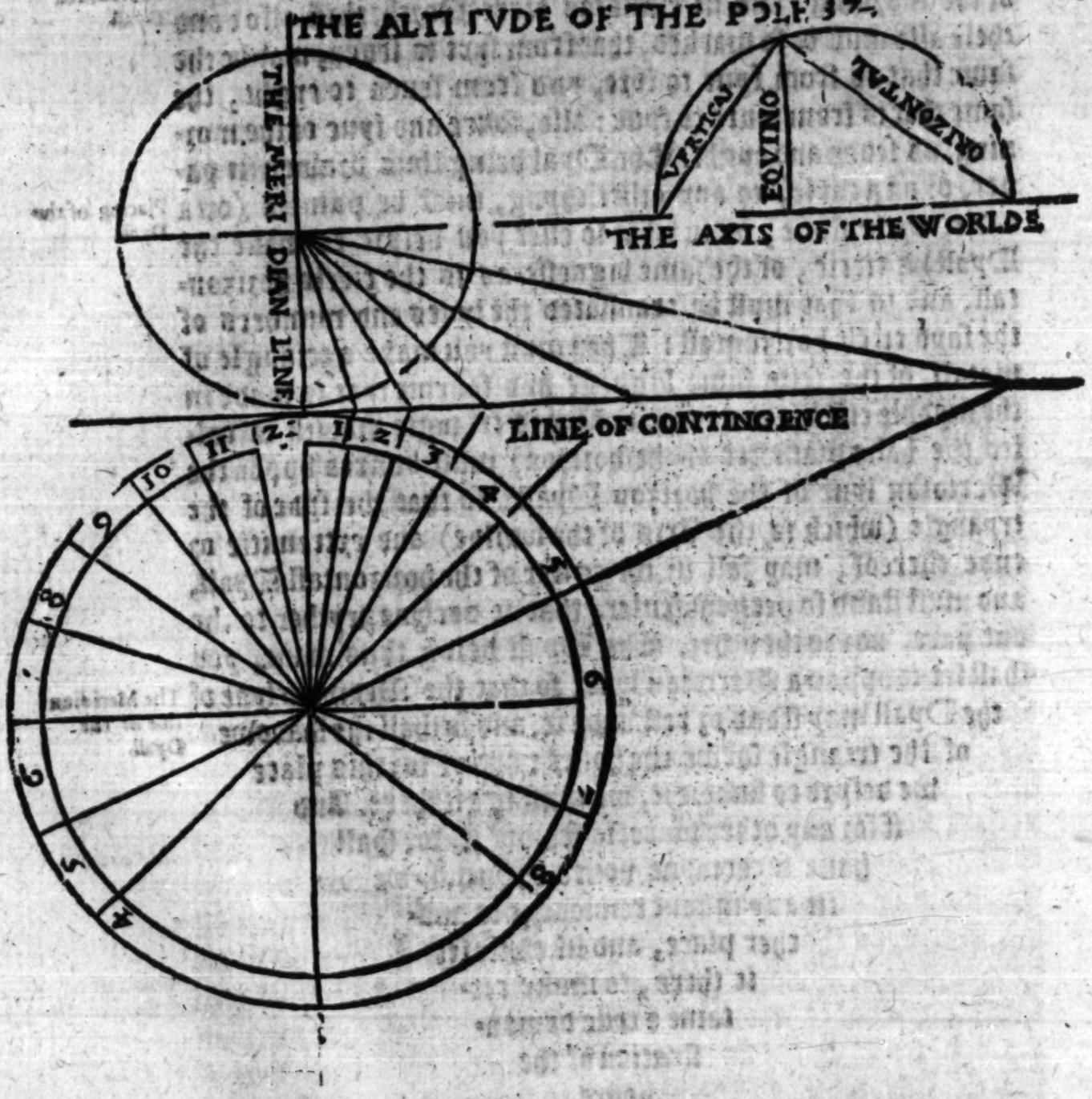
and in climates farre North xi. also, and more if néede shall require, and consequently must haue the houres of fiue and foure of the morning, and in climates farre North, thrée also: and these also must be so marked, that from syxe to seuen, may be the same that is from fyue to syxe, and from seuen to eyght, the same that is from foure to fyue: also, foure and fyue of the morning, as seuen and eyght. The Dyal being thus drawen in paper, or on a table, or any other thyng, must be painted (on a table, or in stone, or in what so euer you desyre to make the Dyall) a circle, of the same bignesse as is the circle horizontall, and in that must be translated the lynes and numbers of the sayd circle horizontall: Then must you make a triangle of metall, of the selfe same bignesse and fourme that is made in the myddle circle: and the syde of this triangle (which is called the halfe diameter of the horizon) must be fixed vppon the Meridian lyne of the horizon Dyall, so that the syde of the tryangle (which is the Axis of the worlde) and extremitie or ende thereof, may fall in the center of the horizontall Dyall, and must stand so perpendiculer, that it declyne neyther to the one part, nor to the other. The Dyall being thus made, you shall set it vppon a Meridian lyne, so that the Meridian lyne of the Dyall may stand or rest vpon it, and so shall the shadowe of the triangle shewe the houre: and yf for this place we desyre to knowe it, we must fixe it there. And if for any other place, so setting it, we shall haue a certayne houre. So may we in any instant remoone it to another place, and likewise set it there, to make certaine & true demonstration of the houre.

houres of the horizontall Dyall.

Placing of the Dyall.

The Meridian line of the Dyall.

¶ Heere foloweth the Figure of this Demonstration.



The making of the vertical Dyall.

In like maner as is made the Horizontal Dyal, must be made the verticall, taking from the Triangle the Semidiameter of the Circle verticall.

And note, that for the Circle verticall, it shall not be néede-

full

full of moze then sixe houres before nowne, and other sixe after nowne. And the triangle must be fixt in the meridian lyne vpon the side that is called the Semidiameter of the Circle vertical. And yf you will not make a triangle of metall, but that a wyre of Iron may gyue the shadowe, then must you make the sayd triangle of paste or paper. And according to the forme or paterne thereof make the wyre of Iron, and cause the same to be set in all sortes of Dials, as is before.

The xvii. Chapter, of the composition and vse of an instrument generall for the houres of the nyght.

Where as in the Chapters past, I haue described the manner and forme to make two Dials for the houres of the day, me seemeth that for the more perfection of this worke, it would be conuenient here to teach the making of a Dyal to knowe the houres of the nyght, by the Circle which the two Starres, called the Guardians, or the mouth of the horne, doo describe by the mouing of the fyrste moueable. But for as much as it is a common opinion, that in the myddest of Aprill it is mydnyght when the Guardes be in the head, whereof they take the begynnyng of the yeare, I wyll declare how it ought to bee vnderstoode. Certayne it is, that to be mydnyght, is none other thyng but the Sunne to bee by the mouing of the fyrst moueable, to euery one in that part of his Meridyan that is to hym vnder the earth, euen as is to hym mydday, or nowne, when to hym it is in that parte of the Meridyan that is aboue the earth. And in this present yere of 1545. (to be out of doubt hereof) I made experience with a precise Astrolabie, so that the fyrst or foremost Guard Starre. beyng perpendicularly ouer or aboue the North Starre, I found in the Meridyan, where the Sunne maketh mydnyght, the ix. degree of Taurus, whereby it foloweth, that the Sunne being in thys degree, which is at the xix. of Aprill, the same Guard Starre shall be perpendicularly ouer the Norih starre, which

The Guardes starres.

what is mydnyght.

Noone, or mydday.

which is the lyne of the head, and consequently the Sunne being in the nienth degrée of Scorpio, which is at the xxii. of October, the guard starre shalbe in the lyne of the feete: and by thys calculation may be knowen when it shalbe in the ryght or in the leaft, and in all the other lynes: so that they manyfestly erre, that accompt the mydnyght at the xv. of Apryll, when the fyrst guard starre is in the lyne of the head, accompting a terce or thyrde parte of an houre sooner and more then they should doo.

An errour.

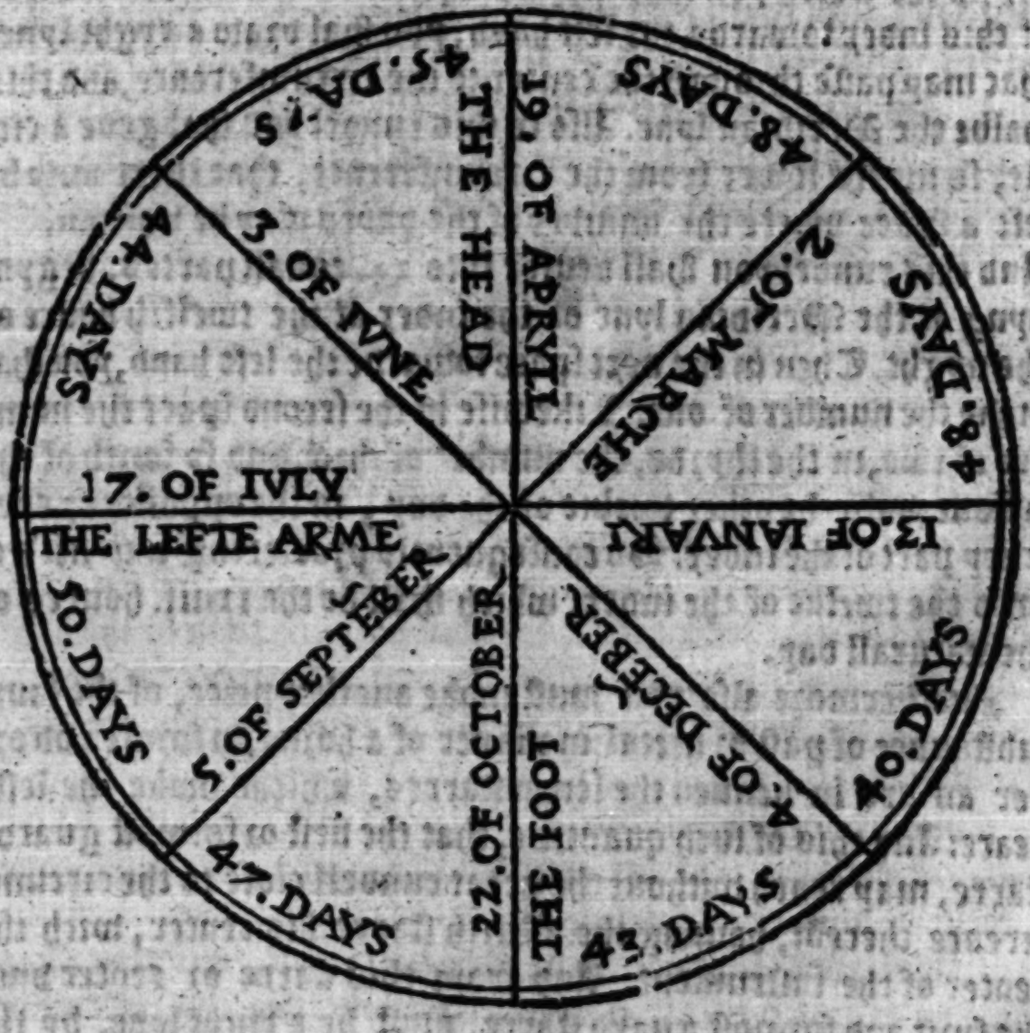
The making of the instrument.

Hauing thus geuen principles for the instrument, you shall proceede in the making thereof, as foloweth. In paste, or on a plate of laton, make a circle of the quantitie of a spanne, or of the bignesse that you desyre the instrument or Dyal to be: then make an other circle somewhat lesse, so farre distaunt from the greater, that betweene the one and the other may be a space, in the which may be signed or marked the dayes and monethes. Likewyse shall you make another lesse circle, leauing space to set the numbers of the dayes of euery moneth. And vnder this circle, shal you make an other, leauing space to write the names of the moneths: then shall you deuide the first and greatest circle into eyght equal partes, so that the xix. of Apryl may be in the highest or vppermost part of the instrument, which is where they say the lyne of the head to be, and the xxii. of October must be in the nether part. Also, the xiii. of Januarie, in the ryght arme: and in the leaft arme, the xvii. of July: and so the other dayes that doo fall to the other lynes, accordyng as they answeare to the ryght assension of the Sunne, as you may see in this figure.

This being thus diuided, you must also diuide the spaces that are betweene the one lyne and the other, into the dayes whiche be numbred in euery space: so that betweene the xix. of Apryll, and the thyrde of June, are 45. dayes, and that space shal you deuide into 45. partes. And whereas the instrument beyng small, it can not in so lytle space receyue so many partes, you shall deuide it from fyue, to fyue partes, and so shall you deuide the other spaces by the numbers that are signed in them.

Then

Then one day more before the x. toward the left hand you shall make a strike, and there shalbe the xx. of Aprył. And fyue dayes more before, make another stryke, and there shalbe the xxv. And yet other fyue dayes more before, whiche shalbe the xxx. of Aprył, make another strike ouerthwart vnto the neathermost circle, and there shall May begyn: And from these dayes shall you begyn to accompt the dayes of May from fyue to fyue. And in the last space you shall put fyue, which shall make the xxxi. dayes that May hath.



And there shall you make another strike, which shall trauerse or ouerthwart vnto the lesse circle. And in this maner you shal deuide the other monethes, geuing to euery of them the number of his dayes.

This being done, vpon the outward part of the great circle, you shal cut downe the paper, paste, or plate of laton, leauing of the same for a signe or marke a floure Deluce vpon the 19. of Aprill, for that it must be the head: and lykewyse at the 22. of October, may be left a handel to holde it by. Then must you make a rundel to the same paste or laton, of the bignesse of the lesse circle, without the circumference whereof, shalbe left a toth or inder, in the which you shall wryte, Tyme. And from the one syde of this inder towards the left hand, you shal draw a ryght lyne, that may passe through the center to the circumference, and this shalbe the Meridian lyne. Also to this rundel you shal geue a circle, so muche lower from the circumference, that there may be left a space where the number of the dayes may be written. And this rundel you shall deuide into 24. equall partes, begynnyng at the Meridian lyne of the inder at the twelfth houre of the nyght. Then in the next space towarde the left hand, you shal make the number of one. Likewise in the second space the number of two, in the thyrde, the number of three, and so forth of the residue, vnto the other twelue of the day, in the oppolite or contrary part of the inder. So consequently procæding i. ii. iii. &c. vnto the twelue of the inder, which shall be the xxiiii. houres of the naturall day.

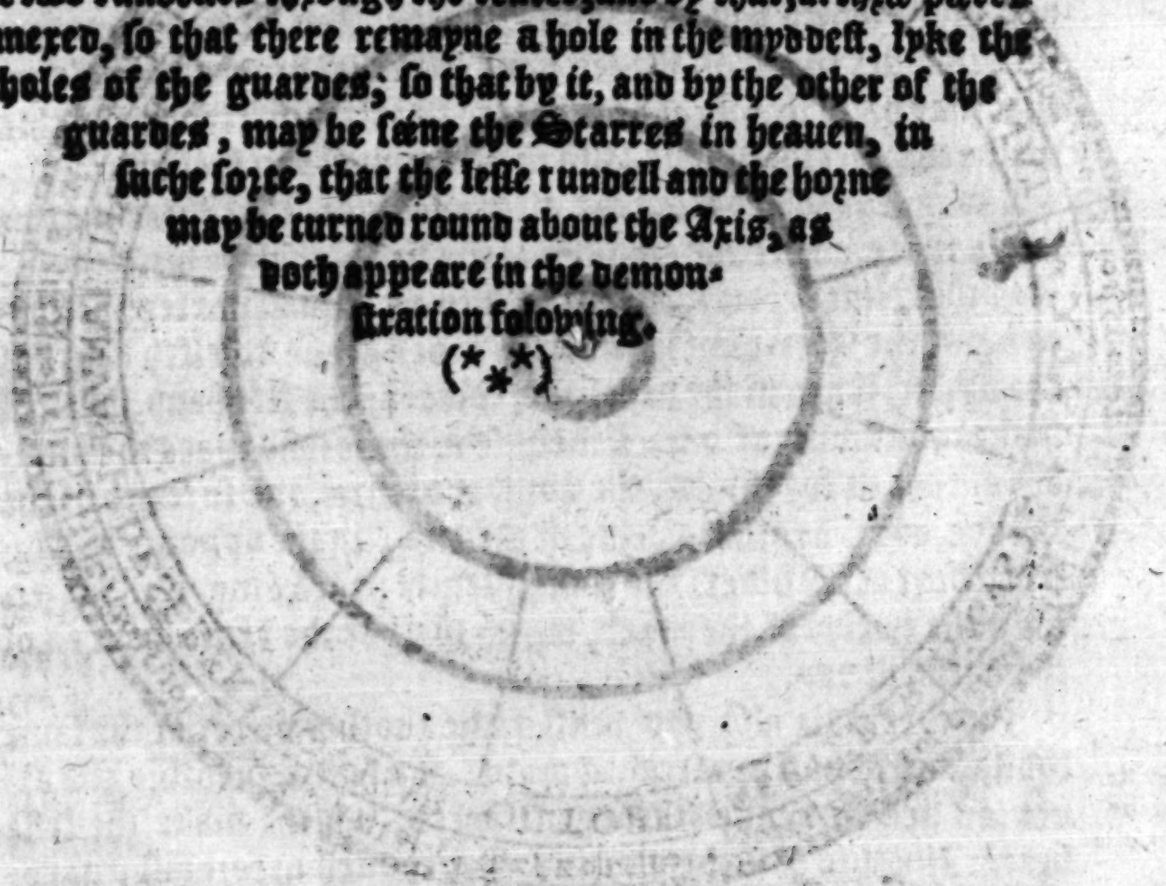
The horne of the seuen starres, whiche make the lesse beare.

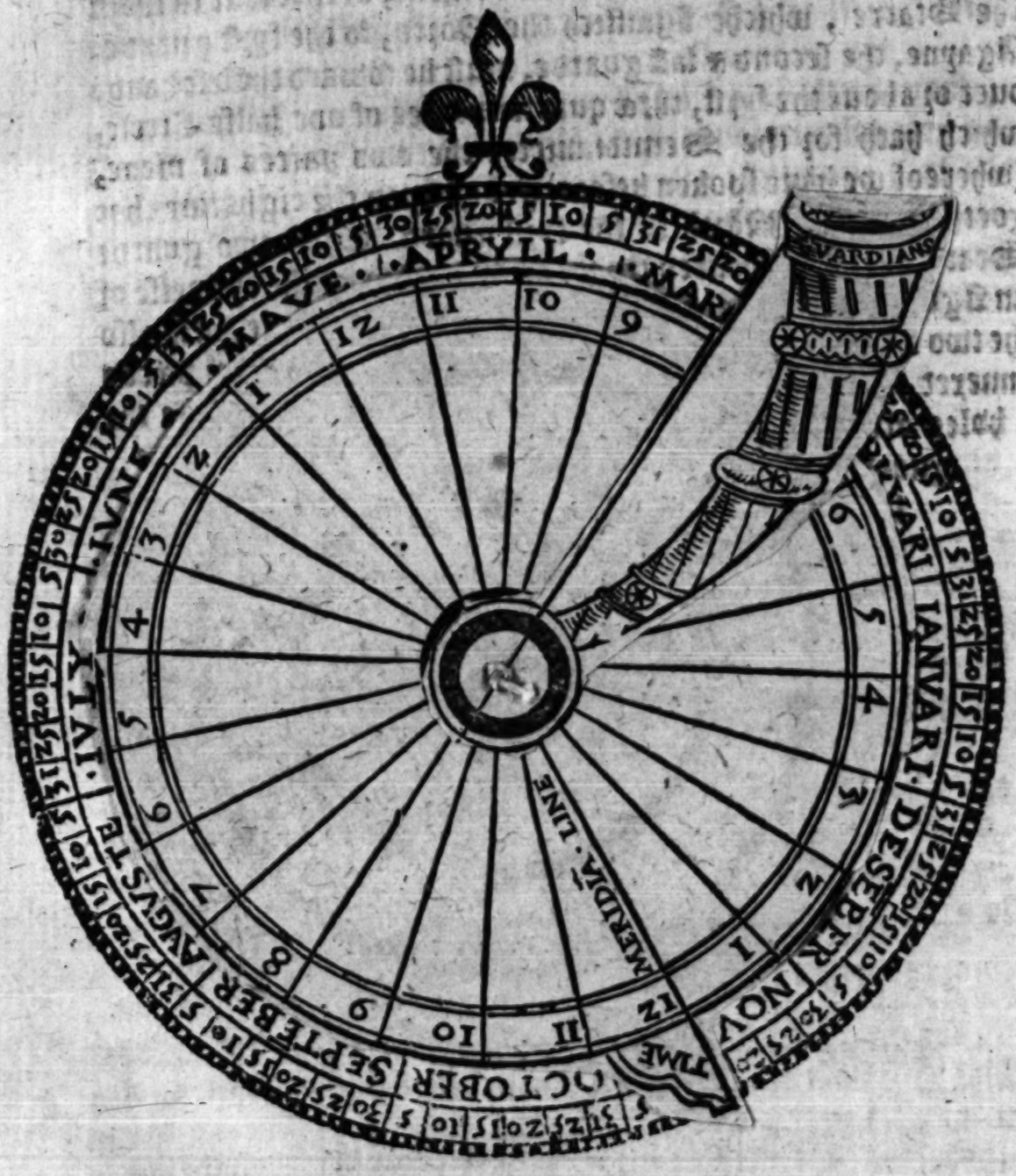
Furthermore also you must make another pæce, of the same substaunce of past or metal, in maner of a horne, in forme and order as are in heauen the seuen starres, whiche make the lesse beare: And this of such quantitie, that the first or formost guarde starre, may reach without the great rundell close to the circumference thereof, hauyng the North starre his center, with the center of the instrument. And from this starre or center vnto the fyrst and formost guard starre, must be a right lyne, by the whiche the horne must be cut neere from the center, vnto the dis-

couering

couering or shewing of the houres. Also, from the fyrst guarde to the seconde, must be two partes of viene, of that that is from the Starre, whiche signifieth the North, to the fyrst guarde. Agayne, the second & last guarde, must be toward the left hand, ouer or aboue the fyrst, thrée quarter partes of one halfe Circle, which hath for the Semidiameter the two partes of viene, (whereof we haue spoken before) geuen vpon the right line that goeth from the North to the fyrst guard. These two guarde Starres, must be boared through with holes, of the bygnesse of an Aglet of a poynt, and lykewyse the North Starre, with also the two rundelles through the center, and by that, al thrée péces annexed, so that there remayne a hole in the myddest, lyke the holes of the guardes; so that by it, and by the other of the guardes, may be séne the Starres in heauen, in suche sorte, that the lesse rundell and the horne may be turned round about the Axis, as both appeare in the demonstration folowing.

(***)





To fynde the hour with the instrument.

The instrument thus ended, and brought to perfection, when you desire to know the houre, you shal turne the index of the lesse rundell in the which is written, Time, to that part of the great rundell where is marked the day in the whiche you desyre to knowe the houre: and directing your face towarde the North, you shal make the head toward the height of heauen, at the 19. of

Aprill

Aprill. And seeyng in heauen by the hole in the myddest the starre of the North, holdyng the instrument in suche compasse of the face, that by the circumference of the greater rundell, may be seene the guarde starre in heauen, you shall turne the horne rounde about, vntyll it fall vppon the Guardes: so that by the two holes of the mouth of the horne, the two Guard starres may be seene, and by the hole in the myddest, the North starre, and all three with one eye: then the right lyne that goeth from the North to the fyrst Guarde, shall shewe in the lesse rundell, the houre that shalbe.

The xviii. Chapter, of the ryme of Tydes, or rysyng and fallyng of the Sea.

GReat accompt ought Pilottes and Mariners to haue of the Tydes, to take Port, enter vppon Barres, passe by Flattes, and finally, for al maner of Nauigations. For beyng ignorannt heereof, great hurt and inconuenience myght chaunce vnto them, as did of late to the valiant Captayne, Don Iohn Gusman the Earle of Niebla, in the yeere of 1436. who was drowned before the Citie of Gibraltar, for that the Mariners kept none accompt, neyther had consyderation of the Tydes. By reason whereof, not onely he was drowned, but also with hym dyed many worthie Gentlemen, and valiaunt Captaynes of Spayne.

The Mariners hold for a certaine rule, that the Moone being in the Northeast, or in the Southwest, is ful Sea: and being in the Southwest, or Northwest, to be lowe Water. They affirme also, that at the fyrst day of the newe Moone, the Sunne beyng at Northeast, and a quarter to the East (that is Northeast, and by East) the Moone shall be Northeast, and then shall be full Sea, and three houres, and three quarters.

The Mariners opinion of ebbyng and flowing of the sea, or tydes.

Obseruation of the Moone to know the tydes.

And

And at the seconde daye of the Moone, when the Sunne shalbe at East Northeast, the Moone shalbe at Northeast, and then shall be full sea, and foure houres, and two quarters. &c. Their accompt is, that the Sunne beyng in the North, is mydnyght: and beyng in the Northeast, they accompte, three: and in the East, syxe. So that they accompte, three houres from wynde to wynde, by the eyght principall wyndes, or lynes, whyche the Spanyardes call Rumbos. These wyndes must bee imagined vppon the North, placed in the Angle, vnder, or beneath the Earth: and the Sunne and the Moone at the mouing of the fyrst moueable, and they ought not to be imagined in the Horizon, as the compasse sheweth. For speaking by the tearmes of Astronomie, you must vnderstande, that the Moone touchyng in the circle of houres at the number of three, is euer full Sea: and touchyng in the same circle at the number of niene, is euer lowe water. No lesse ought they to obserue iuste accompt of the houres, by quarters of houres. For to geue 30. dayes to the Moone, it shalbe necessarie to accompt by the fyftes of houres, as shalbe sayd hereafter.

Eyght principall wyndes.

Heere is to be noted, that the Spanyardes thynke (be lyke) that a Northeast and Southwest Moone, maketh a full Sea in all other places, as it doth in Spayne. But in that they be greatly deceyued, and therefore the rule that they haue set forth for the Tydes, serueth onely for suche places where it floweth Northeast and Southwest Moone a full Sea.

And the better to vnderstand the increasyng and decreasyng of the Ocean Sea, it shall be conuenient to knowe the cause thereof, whereunto we say, that the Moone is the cause of ebbyng and flowyng, or rysing and falling, increase or decrease of the Sea: not onely by her lyght, but also by her secrete or hyd propertie. The Moone compasseth about the earth, from the East into the West, vntyll she returne to the place or poynt from whence she departed: and in this course wasteth or spendeth so muche more then one naturall day, in howe muche her proper mouing is more then the Sunne against the fyrst moueable,

The Moone causeth the ebbing and flowing of the Ocean Sea

The mooving of the Moone.

able, so that she maketh her turne or course about the four quarters of heauen in xxiiii. houres, and foure sythes of one houre, whiche are the twelue degrees that she goeth more then the Sunne. And in this tyme the Ocean increaseth and decreaseth twyse, so that this increasing and decreasing, answereth directly to the course of the Moone: whereby it foloweth, that the sea increaseth syxe houres and one sykth part, and decreaseth other syxe houres, and one sykth. And yf this day at the twelfth houre, was full sea, the lowe water shalbe at the syxth houre and one sykth part: and at the twelfth houre and two sykth partes it shall returne to be full sea: and at the syxth houre and three sythes, shalbe lowe water agayne: and at the twelfth and foure sythes of the other day, shalbe ful sea. So that from one day to another, the tide doth shorten foure sythes of an houre, which is the time that the Moone slacketh or tarieth more then one natural day, to returne to the poynt from whence she departed by the twelue degrees, whereof we haue spoken. Whereby it manifestly appeareth, how they beguyle them selues that say, that the sea increaseth syxe houres, and decreaseth other syxe. For yf it were so, the tydes should euer be at one selfe same tyme and houre. But for as muche as there is more then xxiiii. houres, by the saide foure sykth partes, thereby is caused the variation of the tydes: so that if this day, the tyde be at one of the clocke, to morow it shalbe at one and foure sykth partes, and the day folowing, at two of the clocke and three sythes. &c.

The shortning of the tydes.

An errour.

The variation of the tydes.

For this accompt, I wyl describe a Table in circular figure, although not precise, for the causes which we haue touched before in the fyfth Chapter, speaking of the Moone: who sometymes in her mouing is swyft, and sometyme slacketh as much, because the coniunction is not euer in one selfe same poynt of the Zodiacke, as ỳ Mariners presuppose for their rule. This figure shall haue two circles, in the lesse (whiche shalbe the fyrst, and next vnto the center) shalbe the hayes of the Moone, from one to thirtie, which we count the coniunction. And in the seconde and greatest circle, shalbe founde the houres of the tydes. So that, who so desyreth to knowe when the tyde shalbe, where it floweth Southwest and Northeast, let hym at that houre take

A Table to knowe the variation of the tydes.

heede to the dayes of the Moone, how many they are: as if thee be in the conjunction, or if it be the fyrst or seconde of the Moone, &c. And the day beyng knowen, then in the second circle which answeareth directly to the day, shall bee fynde when shalbe hygh water, or full sea: and consequently, the ebbe, or low water, which shalbe syxe houres and one fyfth, after the full sea, and so lykewyse may he iudge when shalbe the halfe tyde: and this aswell at the time when it encreaseth (which shalbe thyee houres and halfe a fyfth part of an houre, before the full sea) as also when it decreaseth, which shalbe the halfe ebbe, thyee houres, and halfe the fyfth of one houre, after the full sea.

¶ The Table foloweth.

This increasing and decreasing of the Tydes, is not euer in equall quantitie. In the coniunctions and oppositions, they increase and decrease much, which the Mariners cal hygh spring tydes, and the greatest increase of al, they cal the hygh springes. In the quarters of the Mone (which are at the 7. and 22. of the Mone, or neare there about) they increase and decrease but litle: which the Mariners cal neape tydes, low water, dead waters, or lowe flowdes.

The xix. Chapter, of certayne signes, which prognosticate tempestes, or fayre weather.

A God Pilot or Mariner, ought not to be ignorant of certayne signes or tokens which the naturall Philosophers describe of tempests. For as they signifie vnto him, so shall he leaue his porte, or enter into it: which yf he can not, then ought he with patience and hope, to tary the tyme that God hath appoynted for hym, who moueth and troubleth the Seas, when it pleaseth hym, and appeaseth them agayne at his pleasure. Lesse hurteth and damageth the stroke whiche we se comming, or foresee, then that which hath stricken vs, and taken vs carelesse. When the Sunne ryseth fayre and cleare, it signifyeth a fayre day: but yf it shewe pealowe, or deadly, tempest is lyke to folowe. Agayne, yf at the rysing of the Sunne his beames shewe themselues contract, or geathered togeather, and short, you shal haue rayne: if the mistes or cloudes make a circle about the Sunne or Mone, how much the greater that circle shalbe, so much greater shalbe the tempest to come: and yf there shalbe two circles, the tempest shall increase the more. And yf it chaunce, that at the rysing of the Sunne the cloudes be turned redde, it is a signe of no small tempest. When the Sunne or the Mone shall haue a circle, looke towarde the parte where it breaketh, and from thence shall wynde come: yf it depart, or dispearse equally, fayre weather shall follow. When the Mone ryseth bryght and

Signes of faire and fowle weather.

gions by the whyche they passe. We sée that in some one region it rayneth with one wynde, and the selfe same wynde in other places disperseth the cloudes. The Northwest wynde is drye in Spayne, yet in Lybia it is very moyst and rayny. The South wynde in Europe, causeth rayne in most places, and therefore the Poets named it the wynde of waters, and this wind in Palestina or Iurie is drie. The cause of this diuersitie, is, that when the wynde bloweth in Palestina, it passeth by hot and drye regions, as by the desarts of Affrike, and passeth not by any sea at al. But when it bloweth in these partes of Europe, it must of necessitie passe by, and ouer the waters of the sea Mediterraneum, or the Leuant sea, where it gathereth moysture and causeth rayne. The Leuant or East wynde, in Malaga, and Gibralter, is moyste, and in Sheres De la Frontera, is hot as Hell.

The xx. Chapter, of the bright and shynyng exhalations that appeare in the tempestes, which the Mariners call Santelmo, *or* Corpus sancti.

IGnorance is the mother of errours, and therefore will I not omitte to shewe the naturall cause héereof, although among certayne simple and ignoraunt people, it is accounted for a myracle, that in certayne tempestes on the Sea, the Maryners sée certayne shynyng and bright fyres, which with great superstition they knéele downe vnto, and pray vnto, affyrming that it is Santelmo that appeareth vnto them, and not contented héerewith, some sweare that they haue séene drops of gréene waxe fall downe. Other affyrme that this waxe is of such heate, that if it fall from the top of the Ship, it doth melt the rosen and pitch of the hatches of the Ship, with such other foolish imaginations, and therefore it shall be good briefly

Some cal these the fiers of S. Elin and S. Nicolas.

to speake hereof, to stop the mouthes of such fond and ignorant persons. The exhalations or vapoures of the grosse fumes or smokes that rise from the earth, are constrayned or geathered togeather by the coldnesse of the nyght, and the ayre, and are thickned in the fyrst region of the ayre, next vnto the earth. This may, and is wont to be inflamed or kindled, and yf it finde a body whereunto it may cleaue, it abydeth in that vntyll it be consumed. This fyre is cleare, and shyneth, and yet burneth not. The Grekes call it Polyduces, and the Latines call it Castor and Pollux. It is accustomed to appeare vpon the shrowdes, and oftentymes is seene vpon the pykes of souldyers, in the armies of men of warre, as Plinie wryteth, and this, aswell by reason of continuall smoke, as also by the heate of muche people. Certayne it is, that smoke is none other thyng then fyre dispearsed: as flame is an exhalation or euaporation that ryseth in maner of smoke, from a grosse or fat body, and at the tyme that it ryseth, being geathered togeather, is constrayned into flame, inuestured with fyre. This resplendence or shyning, is also oftentymes seene, not onely in iourneying by lande, but also in sayling by ryuers: and when it appeareth on the lande, it ryseth of the smoke that is geathered togeather with the colde ayre of the nyght, and on the bankes of ryuers: this smoke is geathered of the exhalations of the water, and consequently beyng kyndeled, appeareth bryght and shyning. But nowe let vs come to the Shyps that sayle by the Sea, and to the Mariners that are accustomed to tempestes. To them therefore I saye, that that lyght, or suche other lyghtes as they se, is engendred of the fumes and smokes of theyr Shyp, with the heate of men couched close and neare togeather in a narrowe place, and when a tempest ryseth, the sayde smoke is thickned, pyll togeather, and beaten downe by the wyndes, in suche sorte, that beyng tolled from one syde to another, it is set on fyre by mouing, and taketh holde sometyme on the shrowdes, and sometymes on the toppe, and sometyme also in the poupe, or in the forecshyppe: So that to se this lyght, or the same to appeare, is a naturall thyng, and not supernaturall.

wandring fyers engendred of exhalations and vapours.

Castor and Pollux.

what is smoke and flame.

Exhalations of the land and water.

Exhalations and vapours engendred in Shyps.

When Captayne Vizerra was at Cozron, in the Emperours Nauie, with his company of Souldyers, he chaunced to be in a tempest, and sawe the sayde fyze of Santelmo, which shozt-ly after descended so lowe, that the Captayne might easily come to it: and taking it in his cloke, he found it to be a litle dzop of water. Some haue thought it to be a certayne shyning flie, called Taros, whiche the sea men some time see in a calme in the Sommer season: and thus Santelmo appeared no moze. The Captayne remayned astonished at the mockerie, and the other perceyued it to be no miracle. The opinion of the Maryners that affirmed it to be Santelmo, may ryse of Sainct Erasmo, Byshop of Naples, who (as they say) not only in his life tyme, but also after his death, was a patrone and helper of Mariners that called vpon him in tempests. This name of Erasmo, they of Naples call Ereemo: and processe of time taking away one e. by the figure of Sincope, remayned the name of Santermo. And the Spaniardes, who neuer can long keepe any strange vocable, call it Santelmo, turning r. into l. Yet of this Santelmo, whereof the Maryners speake, there is neither scripture that maketh mention, nor auctozitie that confirmeth it. I heare say that the Frier pzeachers hadde a religious man, of commendable life, and good conuersation, named Frier Pero Gonzales, bozne in Galizia, and that in his lyfe time our Lozde did certayne miracles by him, and that this is he that shyneth and geueth lyght in tempests. No doubte, but GOD wozketh myracles in his Saintes, and by his Saintes, as sayth Dauid. But yf this seruant of GOD was Pero Gonzales, how then shall he be Santelmo? Another difficultie there is, as touching this lyght: foz there are wzytyngs of mzze antiquitie then the lawe of grace and comming of Christ in flesh, which geue testimonie hereof. Foz the Poet Virgyll, in the second of hys Aeneidos, wzyteth, that this fire appeared vpon the head of Iulius Ascanius. And Titus Liuius in his first booke, affirmeth, that it appeared vpon the head of Seruius Tullius, the sixth King of the Romanes.

A shining flye

A superstitious opinion of the Mariners.

A lye of the fryer preachers.

Psalm. 67.

Testimonie of auncient auchours.

Pom-

Pomponius Auicue ſayth, that Rome began to be buylded in the thyrd yéere of the thyrde Olimpiades, that is, in the tenth yéere of Ionathan kyng of the Iewes, and from the creation of the worlde 3201. yéres, and 729. yéres before Chriſt our Sauiour was borne. The kyngs of Rome were ſeuen, and raigned 244. yéres. Euſebius ſaith, they raigned 246. Seruius Tullius raigned 44. yéres. Tarquinus Superbus 25. yéres after him. So that diſcountyng theſe yéres, it ſhall appeare clearely as I ſay. Although the yéres were not diſcounted, let them reade Diadorus Siculus, an auncient wryter, let them reade Plutarchus, Ariſtotle, and other olde Auctours that haue wrytten héereof, and they ſhall fynde, that yf tempeſtes be neare vnto the Sea, theſe fyres and lightes appeare in them: and appeared not onely to the Gentiles, but at this day alſo appeare to the Turkes and Iewes in tempeſtes. When onely one lyght appeareth, it is taken for an euyll ſigne: And héereof ſayde Propertius thus.

The buildyng of Rome.

The Romane kyngs.

Candida felici ſoluite vela toro.

And why it is an euyll ſigne, this is the cauſe: that if the tempeſt that ryſeth be great, it choketh the exhalation, although yet by the part leaſt troubled, it appeareth. When there are two lyghtes, it ſignifyeth that it is ſufficient to conſume the matter of the tempeſt, or that the tempeſt beginneth to ceaſſe, and the groſſe humour hath the maiſterie. But ſometyme it chaunceth, that two lyghtes appearing, there may be a tempeſt, and one appearyng ſhall not be ſo great, and often tymes there is a tempeſt without any lyght at all ſéene. The blynde Gentilitie called theſe Caſtor and Pollux, and placed them in heauen in the ſigne of Gemini.

One lyght or fyre is an euill ſigne.

Two lyghtes.

Caſtor and Pollux.

Nowe remayneth to aunſweare to one obiection of the Marrines, who ſaye, that neuer man that hath ſéene theſe Fyres, hath perylhed. To this I ſay, that many may ſée, and haue ſéene theſe lyghtes, of whome, ſome haue béen in peryll, and ſome drowned: Notwithſtandyng, no man can affirme,

an errour of the Mariners.

firme, that yf the drowned myght speake, they woulde say that they haue seene them. Therefore the wyse Christian Mariner ought to haue a cleare conscience, and to call for the helpe of almightie God, lyfting vp his eyes and handes vnto heauen, and say with the Prophet, *Saluum me fac Deus, quoniam intrauerunt aqua vsque ad animam meam.* Saue me, oh my God, for waters haue entred euen vnto my soule.

Psalm. 68.

Heere endeth the second part.

The thirde part, entreateth of the composition and vse of Instruments, and Rules for the Arte of Nauigation.

¶ The fyrst Chapter, of the number, order, and names of the wyndes.

SO greatly estéemed was Eolus, kyng of the Eolas Ilandes, or Ilandes of Vulcane, for hauyng reason and knowledge of the wyndes, that they of auncient tyme called hym the god and lord of them. With no lesse consyderation, the prudent Maryner ought not to be ignorant of them, for as much as the vniuersall benefite, and commoditie of Nauigation consisteth therein. And to haue the better knowledge thereof, you shall vnderstand, that wynde is fruite of the ayre, and vapour of the earth: the which by reason of his subtiltie, pearceth the ayre, striketh it, and enforceth it. Other say, that wind, is ayre, moued or tossed by the vehement influence of vapours of contrary qualitie. It is in Latin called Ventus, because it is vehement, and violent, whose force is so great, that it ouerthroweth not onely heapes of stones, or rockes, and casteth downe trées: but also disturbeth the ayre and the earth, and moueth the seas. There are foure principal wyndes, which come from the foure cardinall or principall poyntes of the Horizon. We haue sayd that the Meridian circle, cutteth the Horizon in two poynts (that is) in the North and in the South, and the Equinoctial cutteth it in other two, that is, in the East and West, and from these foure poynts come these foure windes, whereof all the whole Scripture maketh mention. These foure wyndes, they in auncient tyme, named in this manner. That that commeth from the East, they called Subsolanus, which we call the Leuant, or East wynde.

why Eolus was fayned god of winds.

what is winde.

The foure principall or Cardinall wyndes.

Luke. xvii.

East.

That

That commeth from the South, they named Auſter, whiche we call the Meridian, or South wynde. That commeth from the Weſt, they call Faucinus, whiche we call the Ponent or Weſt. That from the Northe they named Septentrio, or Aquile, or Boreas, which we call Northe. To euery of theſe foure wyndes, they adioyned two collaterall wyndes, in maner as followeth. That that is from the Eaſt towarde the parte of the Northe, where the Tropike of Cancer arryſeth, or cõmeth forth, they called Vulturnus: and that that is from thence toward the part of ỹ South, where ryſeth the Tropike of Capricorne, they called Eurus: alſo that is from the Weſt toward the part of the South, where the Tropike of Capricorne goeth downe, they cal Aphricus: & that that declineth to the Northe, where the Tropike of Cancer goeth downe, they cal Caurus. The Collaterals of the Northe and the South, anſwearcth to the circumferences of the Polar circles: that that is from the Northe towarde the Leuant, or Eaſt, they call Aquilo: and that declineth towarde the Weſt part, they cal Circius: that is from the South toward the Eaſt, Euro Auſter, and towarde the Weſt, Euro Aphricus: thus many hath Ariſtotle in his Metheora. With theſe xii. windes, they ſayled in old time, & made their compaſſe by them.

South.

weſt.

North.

Collaterall wyndes.

Twelue wyndes.

The Hydrographers of late dayes, & ſuch as are trauayled & exerciſed in ſayling, agrée with the auncients in the foure principal wyndes, although they haue chaunged the names, callyng the Leuant, or Orient, Eaſt: ỹ Ponent or Occident, Weſt: the Septentrional, Northe: and the Meridional, South. Betwéene theſe foure windes, they deuide euery quarter of the horizon into two halfes, made of the two neareſt, in this maner. Betwéene the Northe and the Eaſt, takyng name of them both, they name the Northeaſt. Betwéene the Eaſt and the South, they name the Southeaſt: and betwéene the South and the Weſt, Southweſt: betwéene Weſt and Northe, Northweſt. Theſe eyght wyndes in nauigation, they call whole wyndes.

Eyght whole wyndes.

Diuiſion of the horizon by the foure principall wyndes.

Betwéene theſe eyght wyndes, they place other eyght, that are called halfe wyndes, whiche alſo are named of the two that are neareſt vnto them. That that is betwéene the Northe and Northeaſt, they call Northnortheaſt, betwéene,

Eyght halfe wyndes.

Betweene Nozth East, and is East Nozthest: and so forth of the other. Beside these halfe windes, they haue other which they call quarter windes. These take the name of the windes to the which they declyne: as yf to the quarter from the Nozth, towarde the Nozthest, they call it Nozth, and a quarter towarde the Nozthest, that is, Nozth and by East. And that that is toward the Nozthwest, they call Nozth, and a quarter towarde Nozthwest. And so of the other, as shalbe verified in the figure folowyng: whereof is gathered, that deuidyng the eyght pzincipall wyndes into halfe wyndes, they are 16. And euery halfe wynde deuided into two quarters, are in al 32. wyndes. Some haue ben so curious, oz rather so vaynely carefull and ouer precise, that they haue deuided them into 64. And in the Cards that they haue, the confusion of lines is greater, then the profite that may be taken thereby.

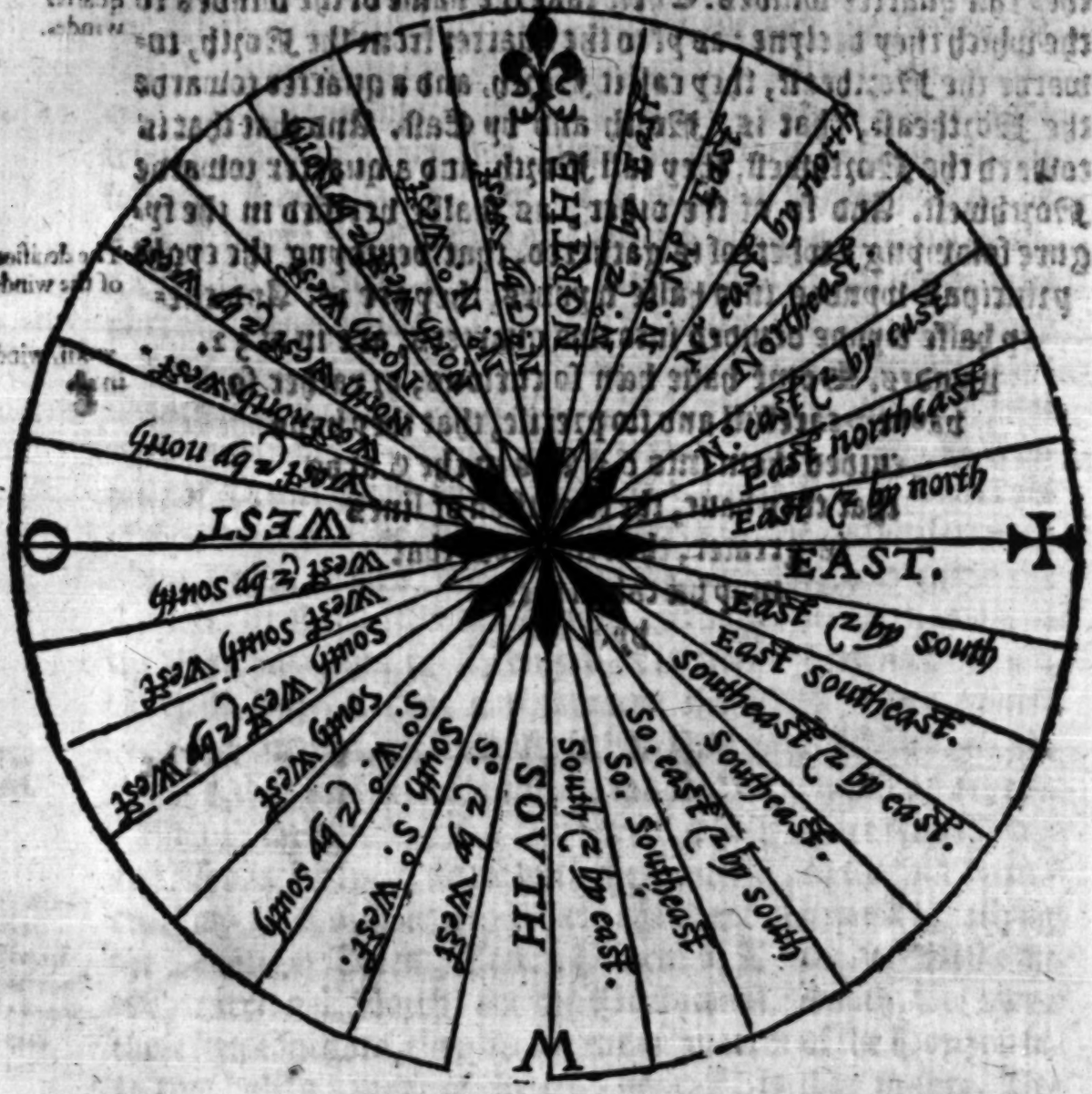
quarter windes.

The deuision of the winds.

xxxii. windes in all.

(The

The demonstration of the wyndes.


NORTH
N. by East
N.N.E.
N.E. by north
Northeast
N.E. by east
East northeast
East by north
EAST.
East by south
East southeast.
Southeast by east.
Southeast.
So. southeast by south
So. Southeast
South by east.
SOVTH
S.S.W. by west
South S.W.
S.W. by south
South west
South west by west
West southwest
West by north
WEST
West by south
West southwest
South west by west
South west
South S.W. by south
S.W. by west
S.W. by south
South S.W. by

and Libeico, becauſe it commeth from Lybia, and Syroccho, becauſe it commeth from Syria, and begynning at the North, theſe are their names, Tramontana, Græco, Leuante, Ponente, Maeſtro, and that that is betweéne Tramontana and Græco, they call Græco Tramontana, and that is betweéne Græco and Leuante, they call Græco Leuante, and that is betweéne Leuante and Syroccho, they call Leuante Syroccho, and that is betweéne Syroccho and Mezzo Iorno, they call Mezzo Iorno Syroccho, and ſo of the other: and the lyke of the quarters. And becauſe they that ſayle in the Ocean, are gouerned by altitudes, we will vſe the names that they vſe, where we intende to intreate of altitudes, and euery man ſhall vſe them as he lyſteth, for as much as the difference is not in the windes, but onely in the names.

The ſeconde Chapter, of the compoſition of Cardes for the Sea.

ARriuyng to the end deſyred (which is Nauigation, the principall intent why I began thys worke) I ſay, that Nauigation or Sayling, is none other thing then to iourney, or vyage by water, from one place to another, and is one of the foure difficulteſt thirgs, whereof the moſt wiſe King hath written. Theſe viages do differ from viages by land, in three things: for the land is fyxme and ſtedfaſt, but this is fluxible, wauering, and remoueable. That of the lande, is knowen and termined by markes, ſignes, and limittes: but this of the Sea, is vncertayne and vnknowen. And yf in viages by land, there are hylles, mountaines, rockes, and craggie places, the Sea payeth the ſame ſeuen folde with tormentes and tempeſtes: therefore theſe viages being ſo difficult, it ſhalbe hard to make the ſame vnderſtood by wordes or wryting. The beſt explication, or inuention, that the wittes of men haue found for the manifeſting of this, is to geue the ſame paynted in a Carde.

VVhat is Nauigation.

Proverb. xxx.

The daunger and difficulti of nauigatio

For

Making of Cardes for the Sea.

For the draught, or making whereof, it shall be requisite to know two things: whereof the one is, the right position of places, or placing of countries and coastes. The other is the distances that is from one place to another, and so the Carde shal haue two descriptions. The one that answeareth to the position, shalbe the wyndes, whiche the Mariners call lynes or poyntes of the compasse: and the other that answeareth to the distances, shalbe the drawing and poynting of the coastes of the land, and of the Ilandes compassed with the sea. To poynt the wyndes, or lynes, you must take skynnes of Parchment, or large Paper, of suche bygnesse as you wyll the Carde to be, and in it drawe two ryght lynes with blacke inke, whiche in the myddest shall cut or deuide them selues in ryght angles, the one accordyng to the length of the Carde, which shalbe East and West, and the other North and South. Vppon the poynt where they cut, make a center, and vpponit, geue a priuie or hid circle, whiche may occupie in maner the whole Carde. This circle, some make with lead, that it may be easily put out: these two lynes deuide the circle into foure equall partes, and euery part of these shall you deuide in the myddest with a pricke or puncte. Then from one puncte to another, drawe a ryght Diametrall lyne with blacke incke: and so shall the circle remayne deuided with foure lynes, into eyght equal partes, which corresponde to the eight windes. In like maner shal you deuide euery of the eight into two equall partes, and euery part of these is called a halfe wynde. Then drawe from euery puncte, to his opposite Diametrall a ryght lyne, of grene, or azure: lykewyse shall you deuide euery halfe wynde in the circle, into two equall partes. And from these punctes, which deuide the quarters, you shall drawe a certayne ryght lyne with redde inke, whiche also shall passe by the center, whiche they call the mother Compasse, or chiefe compasse of the Carde, beyng in the myddest thereof: and so shall come forth from the center, to the circumference 32. lynes, whiche signifie the 32. windes. Beside these said lynes, you shall make other equal distant to them, and of the selfe same colours, in this maner. From the poyntes of the wyndes and halfe wyndes that passe by the center, drawe certayne ryght lynes, that passe

The wyndes or lynes are called Rumbes, in the Spanish toong

The mother compasse of the Carde 32. lynes which signifie so many windes.

not

not by the center, but be equally distant to those that passe by the center, and of the same colours and equidistance, as are they that passe by the center. And as these lynes concurre togeather aswell in the center as in the poyntes of the wyndes, and halfe wyndes, that are in the circumference of the circle, they shall leaue, or make there other syxtæne compasses, euery one with his thyrtie and two wyndes. And if the Carde be very great, because the lynes may not goe farre in sunder, yf you will make there other syxtæne compasses, you must make them betweene the one and the other of the syxte syxtæne poyntes, where the quarters are made with thyrtie wyndes, as we haue sayde. It is the custome for the most part, to paynt vpon the center of these compasses, a flowre, or a rose, with diuers colours, & gold, differencing the lynes, and marking them with letters and other markes: especially signing the North with a flowre Delure, and the East with a Crosse. This beside the destinction of the wyndes, serueth also for the garnishing of the Carde. And this for ỹ most part is done after that the coast is drawne. And thus much sufficeth for the draught of the wyndes.

The placing of many compasses in the Carde.

The flower, or rose of the center.

The North.

The situation of the places, Portes, and Ilandes in the Carde, accordyng to theyr proper differences, consysteth in the particuler, and true relation of suche as haue trauayled them, and therefore for this purpose it shall be nedefull to haue paternes of Coastes, Portes and Ilandes, which must be paynted in the Carde, and these of the best & most approued to be true: and not only to haue paternes well paynted, but also it shall be necessarie to know the true altitudes of the Pole, of certayne principall Capes, Portes, and famous Cities. This done, they must be translated into certayne thinne papers, & transparent, that may be sene through, and those of the best and finest that may be had, annoynting them with oyle of Line sede, and then drying thē at the Sunne. Then take the paterne or Card that is to be translated, and reache or stretche it forth vpon a table. Then put the transparent paper, vpō the one side of the paterne where you wyll begyn. And the paper being made fast vpon the

The situation of the place, &c.

Translation of the Carde, from one to another.

paterne with plomettes of leade, or a lycle waxe, that may eaſily be taken off, you ſhal in the tranſparent paper marke with a fine penne, one Eaſt and Weſt, and one Nozth and South, or two, vpon thoſe that are ſéne by the ſelfe ſame paper in the paterne. And this is called tracyng, or tranſlatyng. In lyke maner ſhall you trace all the Coſtes, Hauens, Ports, Iſlands, Cities, Capes, and riuers, as appeareth in the paterne, vnto the rockes that come forth of the water, and the knowne bankes. And becauſe this paper doth not ſuffice, you ſhall put thereto another, and more, as nede ſhall require. And begyn the tranſlation in one, where the other endeth, vntyll you haue tranſlated all that you deſyre, not forgetting to make in euery one, lynes of Nozth and South, Eaſt and Weſt, to ſerue for markes afterward, ſo that the lyne of Nozth and South, of the one paper, may ioyne cloſe and euen, with the lyne of the Nozth and South of the other paper that is ioyned to it by longitude.

And the paterne thus tranſlated into theſe papers, you muſt put the ruled or lyned paper or papers vpon a playne, ſmooth, and ſtedfaſt table, where you ſhall ſtretche them forth, and make them faſt with plomets or weyghts, or nayle them to the table by the ſides or corners, with ſmall nayles. Then vpon the ſayd ruled paper, you ſhall put the paper that is tranſlated from the paterne, in that ſide or part that is correſpondent from the paterne, to the ruled Carde, ſo that the lynes of Eaſt and Weſt, Nozth and South of the tranſlation, may be vpon the lynes that anſwere to them in the ruled Carde.

This paper thus made faſte by the one ſyde or part, you ſhall by the other ſyde (that it may remayne in his place) put vnder it an other fyne paper, ſmoked or ſmyred on the neathermoſt part (which is that, that falleth vppon the ruled Carde) eyther wyth a lynke, or with matches of pitche. Theſe thus ordered, and made faſt one vppon another, you ſhall take a ſtéle bodkyn, or wyre, with a ſmoothe and blunt poynt, that it race not, or bore not the paper, and with it ſhall you drawe, preſſyng vppon all the tranſlation, and tracing it with diligence

Some do this only with eyle.

Tracing of the Carde.

and

and discretion, marking euer how much in it is translated from the paterne: sauyng the wyndes or lynes which the Maryners call Rumbos, and so shall remayne all the impression of the smoke in the ruled Carde, vppon the whiche, with a fyne penne you shall trace with pnke: whiche beeyng drye, you shall with crummes of bread make it cleane from all the smoke, and so shal the coaste appeare in the Carde drawne with pnke.

This doone, then with a small penne shall you describe in the Carde, all the places and names of the coast in that part where they are, and as they are seene in the paterne. And first you must describe in redde, the Portes, principal Capes, famous Cities, with other notable thynges: and all the residue in blacke. Then shall you drawe or paynt Cities, Shyps, Manners, and beasts, and also marke the Regions, and other notable thynges. Then with colours and golde shall you garnyshe and beautifie the Cities, Compasses, Shyps, & other partes of the Carde. Then shall you set forth the coastes with greene, by the shore or bankes of the landes, and make them fayre to syght with a litle saffron, or otherwyse, as shall seeme best. Lykewyse shall you describe certayne letters, with theyr significations, in thys maner. The paynting of the Carde.

B. for a Bay. C. for a Cape. A. for an Angle. I. or Y. for an Ilande. M. for a Mountayne. P. for a Porte. R. for a Ryuer.

Then in place where is more roome, or that is least occupied, you shal drawe two right lynes, equally distaunt: and the one no further from the other then half a finger, or litle more, and so long, that betweene thē may be marked at ꝑ least three hundred leagues. And this the Maryners call the truncke or scale of leagues, and place it or vse it in this maner. They take with ꝑ compasse, a hundred leagues of ꝑ trunke of the Carde or paterne ꝑ is translated, and they set them iust betweene the two lynes, and this space they part by the halfe, and reste the foote of the compasse in 50. and these deuided againe equally in two parts, they reste the compasse in 25. and the 25. beyng lykewyse deuided, they The making of the trunke or scale of the leagues.

they rest in xii. leagues and a halfe, and marke them as appeareth in the demonstration folowing.

The graduation of the Carde.

The Carde beyng thus made, then to graduate it, or deuide it into degrees, you must drawe three lynes, whiche make ryght angles with the lyne of East and West, equidistant to the lyne of North and South: and they also shalbe North and South. These shall be drawne by the Ilandes of Açores, or Soria, or nearer to Spayne, or where the Carde shall be lest occupyed. And for this purpose, the one lyne must be so farre distante from the other, that in the two spaces which they make, may be marked, in the one, the degrees, & in the other, the number of them, conformable to the graduation of the paterne: as the numbers of degrees shewe East and West, with the Ports, Capes, and coastes in their proper altitudes.

And if the Carde haue no graduation, you shall take with the compasse in the trunke of the leagues, seuen spaces of 12. leagues and a halfe, which are 87. leagues and a halfe. And these must be deuided into fiue partes, which come forth at 17. leagues and a halfe for a part: and the foure partes taken with the compasse, make foure degrees, and deuided into foure partes, euery part is a degree, and is marked thus. o.

The marke of a degree.

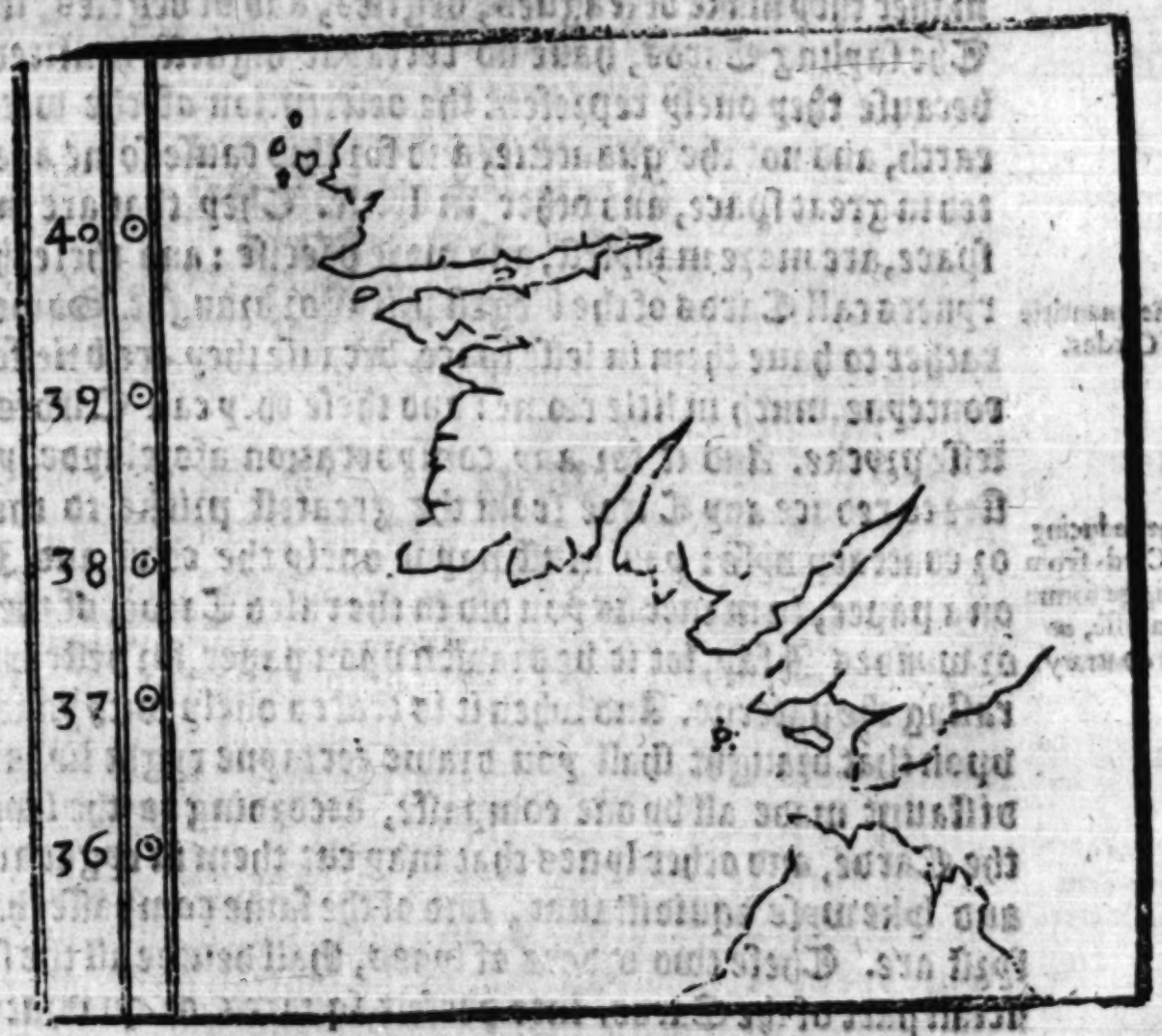
And yf you wyll make the degrees at 16. leagues, and two terces or more: you shall geue to euery degree so much space as the leagues comprehend. This graduation must be begun from some one cape, whose altitude of the Pole is well knowen. And the whole Carde being thus graduate, you must begin the number of the degrees from the Equinoctiall lyne, one, two, three. &c. toward the one Pole, and the lyke toward the other: so that to the knowne Cape, may answeare the number of his altitude. And so shall you do to the whole Carde. Also, the Equinoctiall lyne shall be marked in his proper place.

And

And in lyke maner shal you marke the Tropikes according as they are in ꝑ sphere. But forasmuch as in Spayne, Cape saint Vincent is the principall, they beginne there to make graduation, & number it in 37. degrees. And from thence towarde the Pole Artike, the degrées dow encrease. And from thence towarde the Equinoctial line, they diminish: and from that lyne, to the pole Antartike, they encrease againe (as we haue sayd) as is conteined in the Carde, and as appeareth in this demonstration following.

Cape S. Vincent.

Increasing and diminishing of the degrees.



And if the paterne haue neyther leagues nor degrées, you must take or know the altitudes of two Capes, that are North, and South, of the degrées, and the difference of the degrées of the elevation, that is from the one Cape to the other, ye shall deuide all that space in so many partes, and so the one parte shalbe seuenténe leagues and a halfe, as answereth to one degrée.

If the paterne haue neyther league nor degree.

gree. Dr according vnto the opinion of the leagues of the roundnesse of the earth, as we haue sayde, as touchyng this in the eyghteenth Chapter of the fyrst part. In Spayne they vse with the compasse to take the space that is from Cape saint Vincent, to the myddest of the greatest Alande of Berlinga, whiche they account thre degrees: so that after seuenténe leagues and a halfe for a degree, they are 52. leagues and a halfe: and so much do they put in this space. Other put fiftie leagues, accompting after syxténe leagues, and two terces for a degrée, and in this maner they make of leagues, degrées, and of degrées, leagues. The sayling Cards, haue no certayne bignesse limitted them, because they onely represent the description of the water and earth, and not the quantitie, and for this cause some are paynted in great space, and other in lyttle. They that are in great space, are more manyfest, and more precise: and these the Mariners call Cards of the largest pricke or draught. Some desire rather to haue them in lesse space, because they are briefter, and conteyne much in litle rowme: and these they call Cardes of the lesse pricke. And if for any consyderation aforesayde, you desire to reduce any Carde from the greatest pricke to the least, or contrary wyse: you must paynt onely the coast and Islands on a paper, in maner as you did in the ruled Carde, of the lynes or wyndes, I say, let it be drawen vpon paper, for destroying or rasing the paterne. And when it is traced onely with yake, then vpon that draught shall you drawe certayne ryght lines equidistaunt made all by one compasse, according to the length of the Carde, and other lynes that may cut them in ryght angles. and lykewyse equidistaunt, and of the same compasse that the fyrst are. These two orders of lynes, shall deuide all the superficiall part of the Carde, into perfect squares or quadratures. And it is to be noted, that the nearer the lynes are ioyned together, and the squares the lesse, so muche the more perfectly may it be reduced, and more easily. Then shall you take another paper, greater or lesse then the Carde, according to the poynt that your desyre to reduce it vnto, and in the length and breadth thereof, you shall deuide so many spaces as are betweene the lynes of the other paper, and yf it bee

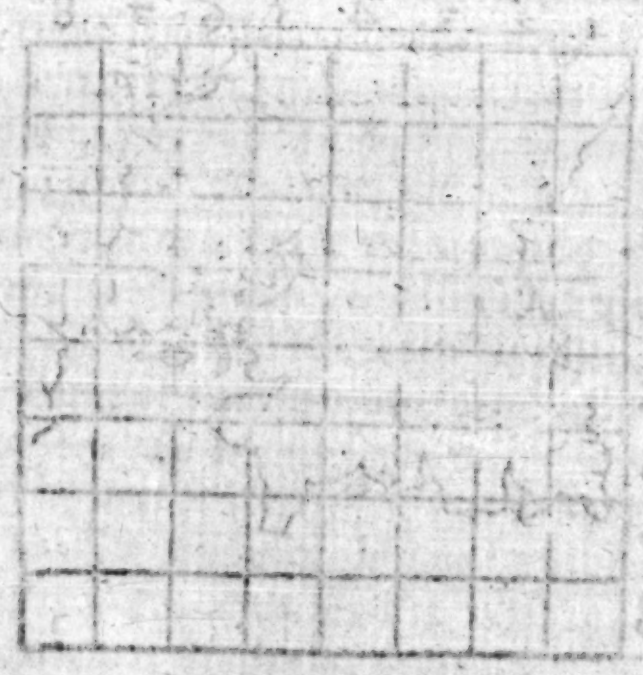
The quantitie of Cardes.

The reducing of Cards from a bigge forme to a lesse, or the contrary.

greater,

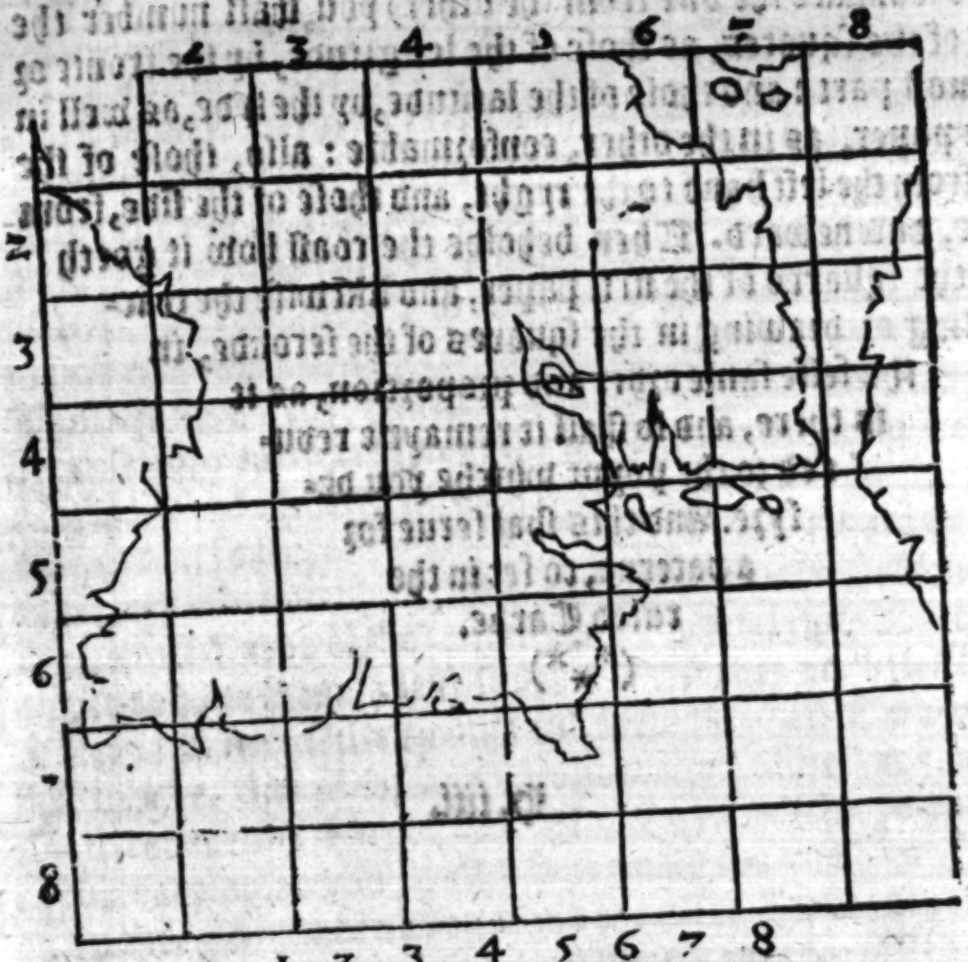
greater, the ſquares ſhalbe greater: and if leſſe, leſſe. To kepe order in the correſpondence of the ſquares (which ſhalbe a great lyght to tranſlate the one from the other) you ſhall number the orders of the ſquares, as thoſe of the longitude, by the fronte or vppermoſt part: and thoſe of the latitude, by the ſyde, as well in the one paper, as in the other, conformable: alſo, thoſe of the front, from the left hand to the ryght, and thoſe of the ſide, from aboue, downeward. Then beholde the coaſt how it goeth by the ſquares of the firſt paper, and likewiſe the tracting or drawing in the ſquares of the ſeconde, in the ſelfe ſame order and proportion, as it is there, and ſo ſhall it remayne reduced to the poynt whiche you deſyre. And this ſhal ſerue for a paterne, to ſet in the ruled Carde.

(***)

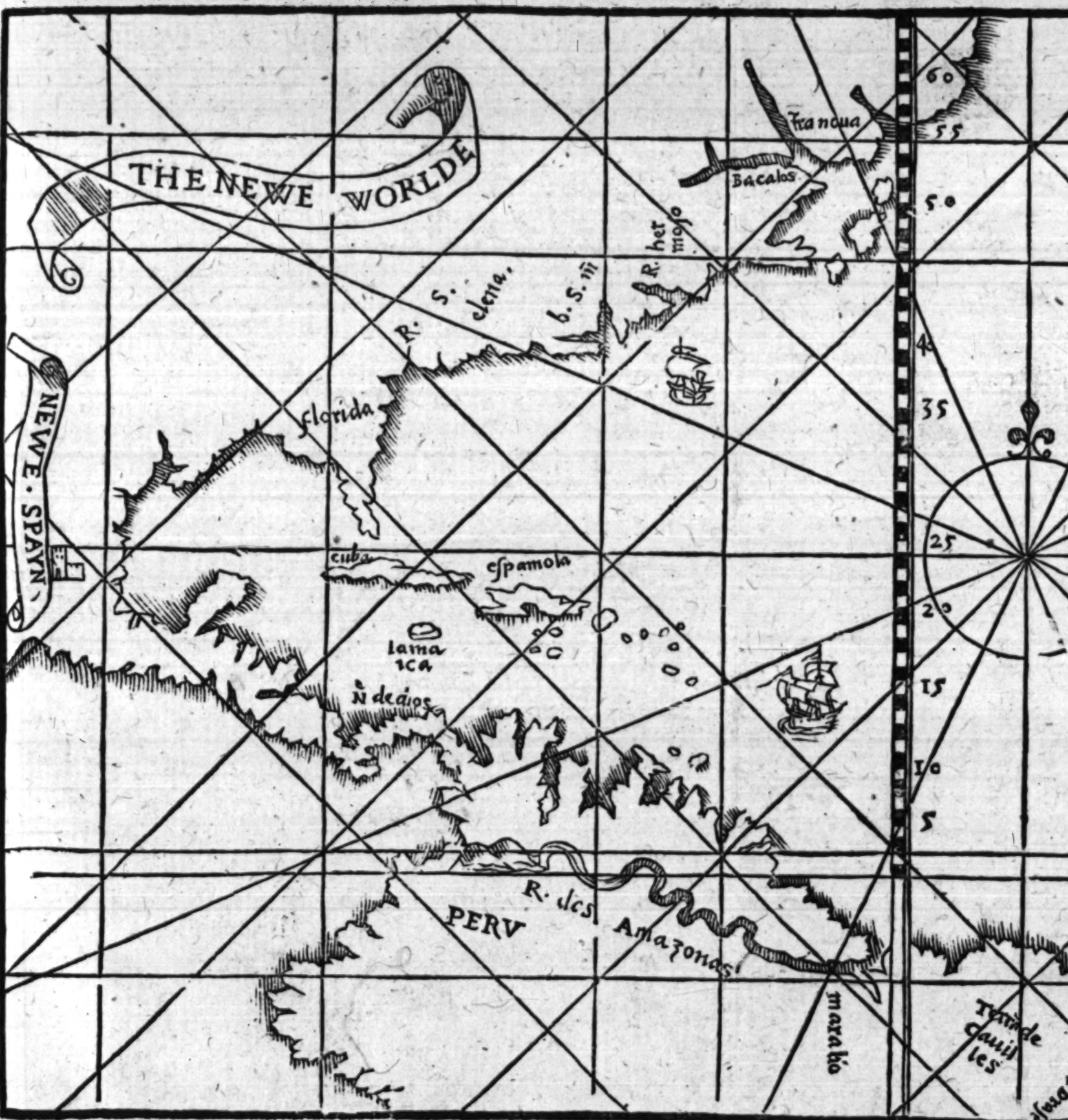


Here followeth a Tranſlatde of the Mariners Carde.

Heere foloweth the maner of the translating of the Card from one fourme into another, greater or lesse.



Here foloweth a similitude of the Mariners Carde.


THE NEWE WORLDE
NEWE · SPAYN
Francua
Bacalos
R. hermoso
R. S. elena.
b. S. m̃
florida
cuba
espamola
lama ica
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R. des Amazonas
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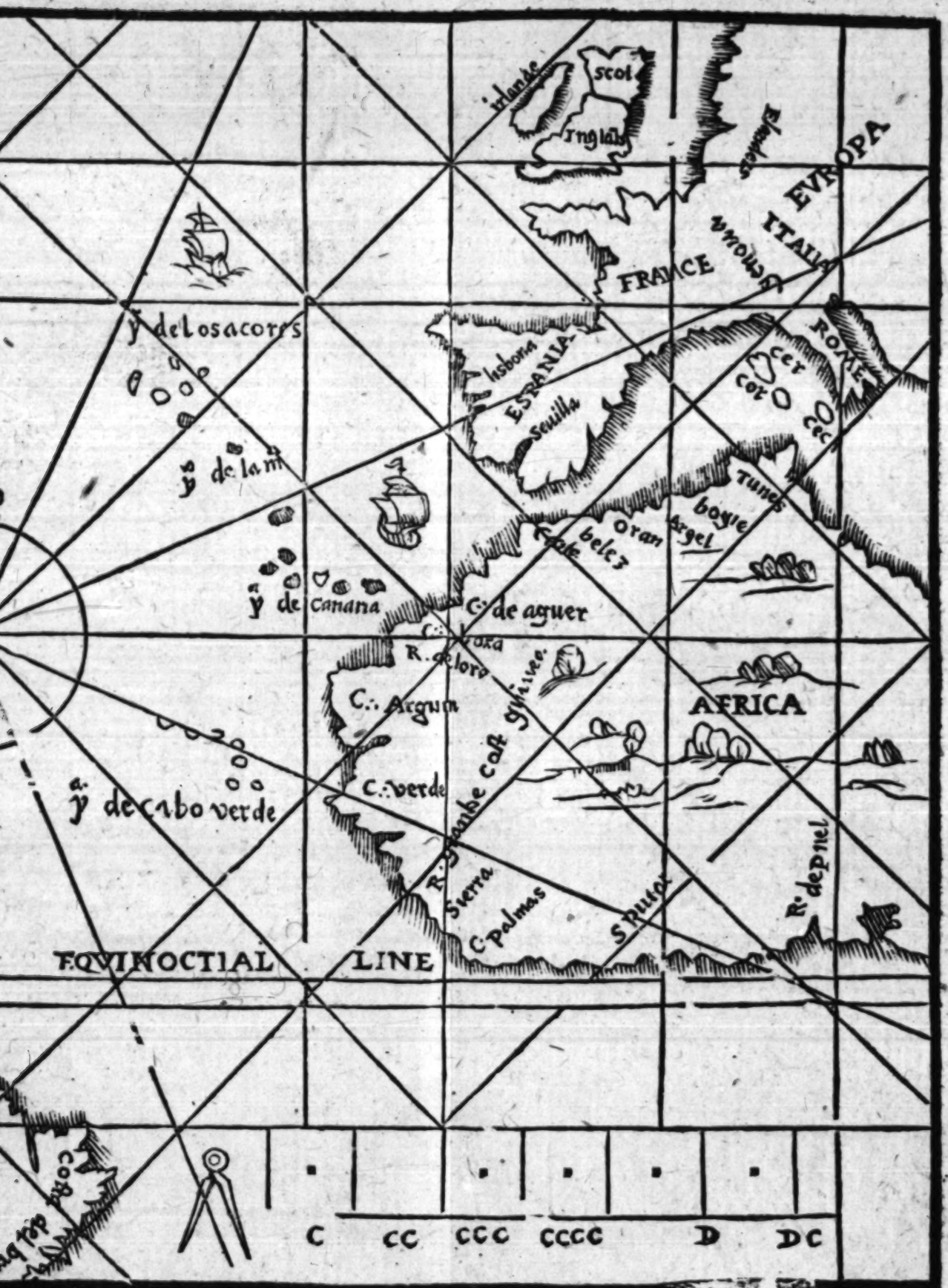


Scot
Inglats
EVROPA
ITALIA
FRANCE
ESPANIA
Seuilla
ROME
Tunes
Argel
Oran
C. de aguer
C. Argum
C. verde
AFRICA
Sierra
C. palmas
EQVINOCTIAL LINE
C
CC
CCC
CCCC
D
DC

The pilots and Mariners neither vse nor haue the knowledge to vse other Cardes, then onely these that are playne, as I haue sayd. The whiche, because they are not Globus, Spheri- call, or rounde, are imperfect, and fayle to shewe the true distan- ces. For in how much they depart from the Equinoctiall, to- ward which soeuer of the Poles, the Meridian lynes are con- tracte narrower and narrower: In suche maner, that if two Cities or poyntes in the Equinoctiall, shoulde be distaunt of longitude 60. leagues, and in the selfe same Meridian at 60. degrées from the Equinoctiall, toward either of the Poles, should be other two Cities or poynts, they should be distaunt in longi- tude but onely 30. leagues. And for the better declaration and vnderstanding hereof, I say, that if two Shyps should depart from the Equinoctiall, the one distaunt from the other a hun- dred leagues by East and Weast, and that either of them should sayle directly by his Meridian toward the North: then when either of them hath the Pole ouer his Horizon 60. degrées, the one shall be distaunt from the other onely 50. leagues by the Paralelle of East and Weast, as appeareth by the playne Cardes, that they haue the selfe same hundred leagues. And beside these considerations, one error bringeth in an other, and so another an other. Whereof to speake any more here, it shalbe to certaine Pilots (as the prouerbe saith) not onely to geue mu- syke to the deafe, or to payut a house for blinde men, but shall al- so be an endlesse confusion. Furthermore it is necessary to con- syder, that good Cardes ought to haue the Coastes, Ports, Ci- ties, and other places, situate according to the wyndes or lynes thereof, proportionally as they are in the world: and not by the wyndes that the compasse sheweth. This I say for the North- easting or Northwesting of the compasse (called the variation) as hereafter I will touche in the fyfth Chapter. And lykewise shall you diligently obserue, that the graduation of the Carde shew the same in their proper altitudes. The Cardes that lacke this, ought to be corrected & amended by wise and expert men:

The playne Cardes are imperfecte.

Example of errour in the playne Cards.

The ignerance of certayne Pilots.

Good Cardes.

The variation of the Compas.

Altitudes.

Sauing

In the narrow seas they sayle not by elevation of the Pole.

Sauing that in the Leuant sea (called Mare Mediterraneum) and in this Chanell of Flaunders (called the narrow seas) it is not conuenient for the nauigation, that the Portes be marked in the Cardes by the wyndes, which the compasse sheweth, for as muche as they sayle not by the altitudes of the Pole. Lykewise, it shal not be inconuenient, but rather very necessary (to auoyde so many errours, of the which do slow great daungers, and suche a confusion) that your Maiestie shoulde commaunde certayne learned Cosmographers, and expert in the arte of sayling, to verifie ỳ altitudes of ỳ Pole, that are of Portes, Capes, Alandes, and people by the coastes of the Sea, and in like maner truely to describe the coastes of the lande, especially of the Nauigation of the West Indies, or Mundo Nueuo, where it hath pleased God that so many nations and people haue receiued the water of holy baptisme, commyng to the knowledge of the true God, whereby the Christian Empire is greatly amplyfyde, besyde the great rychesse had by the sayd Indies. And this hath God miraculously wrought by the conquestes of your Maiestie, in subduing Infidels, and Gentiles, to the obedience of the true Catholique fayth. Whereby, not onely God hath ben well pleased, but also your Maiestie hath receyued perpetuall fame, with eternall renowme, and immortall glorie to your posteritie in worldes to come.

Correction of the sea Carde.

The west Indies.

Charles the fyfth.

The

The iii. Chapter, of the vertue and propertie of the Lodestone, called in Latine *Magnes*, and in Spanish, *Predraymon*.

The Lode stone (as writeth Cardinall Cusanus) hath substance, vertue, and operation. His vertue is engendred of his substance, essence, or being, and of his essence & vertue proceedeth this operation and effect, in such sort, that this stone communicating his vertue to iron, by reason thereof, causeth the iron to moue, although betweéne the one and the other be a cuppe, or plate of syluer, or a table, or any other lyke thing.

The vertue, substance, and operation of the Lodestone

Vertue attractiue.

The attractiue, or drawing force of the Lode stone, causeth the nature of iron to be and rest in it, and that so syrmely and quietly, that being naturally heauy and ponderous, it descendeth not, because his nature resteth not in hym selfe, but is vnite with the nature of the stone, which séemeth to extende it selfe, and as it were to cast forth a liuely spirit of enchaunting vertue. Insomuch that (as we see by experience) by the sayde vnion, it not onely distributeth his vertue to one iron, but that iron likewyse to another, and that other againe to another, and so forth: vntill of many rynges or lynkes of iron, be made a chayne.

Cusan applyeth this to the glorified body of Christ, according to these words, If I shalbe exalted, I will draw all vnto me.

Saint Augustine (as he writeth in his bookes, De ciuitate Dei) did maruayle that he sawe an iron moue it selfe vpon a vessell, by mouing the Lode stone vnder the vessel.

Why the Lode stone was called Magnes, and the kindyng thereof.

It is called Magnes, because the inuentour, or fynder therof, was so named: who (as Plinie writeth) kéeping cattell in East India, had his shoes soled with plates of iron, and iron naples, such as they vse in Gasconie, and had in his hand a staffe wyth a pyke, or hooke of iron: and resting him selfe vpon a quantitie of this stone, could not remoue his féete, neyther lyft vp hys staffe. Then staying a whyle astonyshed, as ignorannt of the cause, at the length began to perceyue the propertie of the stone, and to vnderstande the attractiue vertue thereof (the colour of it differeth not from iron) and was therefore called quicke iron, or lyuing iron.

The

Sundry kinds of the lode stone.

The best kinde of these stones, is of Auzurine or blew colour, as the sea sometimes appeareth.

Of these, are found fyue kyndes or differences. The first is, of Ethiope. The seconde, of Macedonie. The thyrde, of Lechio in Boetia. The fourth, of Troada, neere to Alexandria, And the fyfth of Asia: but at this day, it is founde in dyuers other places. It is founde also in many places in Spayne: as in the hyll Morena, neere vnto the village of Calera, beyng of the ordre of saint James, in the prouince of Leon. Lykewise in a hyll of Moron, in the territorie of the Erle of Vrenia, is great quantitie thereof, and in diuers other places. The stone that we most commonly vse, is of the Ilande of Elua, of the Lord of Pomblina, which I iudge to be better then that of Denmarke. This and the other, haue vertue to drawe iron vnto .he. And true it is that Teanxedes writeth, that in Ethiope is founde an other kynde of thys stone, that putteth iron from it. Auerroes the commentator of Aristotle, denyeth that Magnes draweth iron vnto it, but sayth, that iron by his naturall inclination doth moue to the stone, as to his naturall place, by a certayne qualitie, which the stone impresseth in iron. And beside this vertue and propertie that it hath to drawe iron vnto it, it hath also another: and that is, that it geueth vnto iron vertue and power, to shewe the two poyntes of the Horizon, where it cutteth the Meridian, that is in the two wyndes, of North, and South. These vertues are founde more intent, in onely two partes of the stone: and these are euer opposite, or contrary the one to the other, and so are they contrary in operation. For iron touched with the one part, and placed where it may moue frely, will shewe the North: and an other iron touched with the other parte, wyll shewe the South. Fyndyng this experience, may be knowne, what parte of the stone answeareth to the North, which the Mariners call the face of the stone, and lykewyse of the South. This stone is so necessary, that without it, Nauigation shoulde bee imperfecte and vncertayne, because it geueth lyfe to the Needle and Compasse, which leadeth and guydeth the Pilote, that he maye goe certaynely

The Iadestone of Spayne.

The Iland of Elua.

The lodestone of Denmarke.

The lodestone of Ethiope.

Diuers opinions of the lode stone.

The qualities and properties of the lode stone.

The parts of the lodestone.

VVhat part of the stone answeareth to the North and South.

in

in the daye, and not erre or wander in the nyght. Also it sheweth and directeth to compasse the worlde, and to knowe the wyndes. And therefore, for as muche as the compasse is so necessarie, wee intende to shewe the order and manner howe it ought to be made, for it may chaunce to sayle, or be lost in the viage.

The vse and making of the Maryners compas.

The iiii. Chapter, of the making of the Mariners compasse for Nauigation.

TAke such paste or paper, whereof Cardes are made, and make in it a Circle, of the quantitie of a spanne, or little more or lesse. In the whiche you shall paynte the 32. wyndes, with theyr colours, in suche order as we gaue in the firste and seconde Chapter of the wyndes, and of the Carde, not forgetting to marke the North with a Floure delice, and the East with a crosse. And more then this, may euery man garnishe and beautifie the same, as seemeth best to his phantasie. Then on the lower or neather parte of this paste, you must drawe a lyne, whiche shall be directly vnder that of the North and South, which shall be the marke for the setting of the Irons and Steles. Then shall you take wyre of iron or stele, of the bygnesse of a great pynne, or according to the bygnesse or the roundnesse of the paste, floure, rose or fyre, as it may be called. This wyre must be bowed double, so that euery of the partes may be equally as long as the Diameter of the fyre, and a quarter part more. The endes or poyntes of these irons or steles, must be pynched together, and made close, and open in the myddest, the one from the other, vntyll the endes come to bee equall with the extremities of the Diameter of the fyre, and so shall the steles remayne in maner in fourme of an egge. These wyres or irons must be made fast in the neather parte of the fyre: so that theyr extremities, ends, or

The Floure delise, and the crosse.

The fyre, floure, or rose of the compas.

points,

The lyne of the North and South.

poynts, compasedly by the lyne of North and South.

And to fixe or fasten them so, they must be couered with a thinne paper glued, leauyng the poyntes and endes uncouered: And these endes must be touched with the Lode stone, in this maner. The part that is vnder the floure deluce, must be robbed on that part of the stone that answereth to the North, as is sayd in the Chapter before. And thys shall suffice for the perfection of the compasse. Yet some there be, that for superaboundaunce, doo touche the other part of the Iron, with that part of the stone that answereth to the South, although it may suffice to touche it only with the other parte. This touchyng of the Iron with the stone, that the demonstratiue or worcking vertue may shewe it selfe forth, must be done with geuyng certayne strokes with a hammer, on that parte of the stone wherewith the Iron must be touched, that is to say, in the North part, or the South: And from these wyll come forth of the stone certayne beardes, lyke small yscles, whereon you shall rubbe the point of the Iron, as you would whet a knyfe: and so shall certayne of those beardes of the stone, cleaue and sticke fast to the Iron. And the Irons thus touched, with the beardes cleauing to them, you must take a prick or poynt of laton, of Piramidal, sharp, or steple fourme, which is brode below, & sharpe aboue toward the point, this is made round, or eyght square, as semeth best: and in the neather parte or breadth, it must be bored (but not thorough) with a borer, which must also be of Piramidall fourme, and center into the myddest of the sayde Piramidall prieke, or poynt of laton, vnto the middest, or somewhat more. This Piramidall poynt (which the mariners call the Capitell) must be of height halfe a fynger breadth, or according as the compasse shall be, and must be put through the center of the fyre, so that the poynt come forth on the hygher part thereof, and must there be made fast, and well fixte. Then shall you take a round boxe of wood, within the which the nædle may be, not touching the sydes of the same: And this must be of the heyght of the halfe Diameter of the compasse. And the ground or bottome thereof must be set to it, as to the couering of a boxe, that it may be easely

The touching of the needle with the lode stone.

The breaking of the stone, to draw out his vertue.

The boxe of the compasse.

taken

taken off, and put on, to haue often recourse, to touche the irons with the stone (which they call feeding) when nede shall be, that the vertue of the compasse fayle not. Also in the middest of the ground, or floore of the boxe, you must set a sharpe poynt or pricke, made of a wyre of laton, this must stande ryght vp, and vpon the pricke or poynt thereof, you shall set the bored hole of the Capitel, and that the wynde enter not aboue, you shall couer the boxe with a glasse. And thus being touched with the stone and set vpon the poynt, it shall shewe the true part of the North, and consequently all the other wyndes.

Feedyng the needle with the stone.

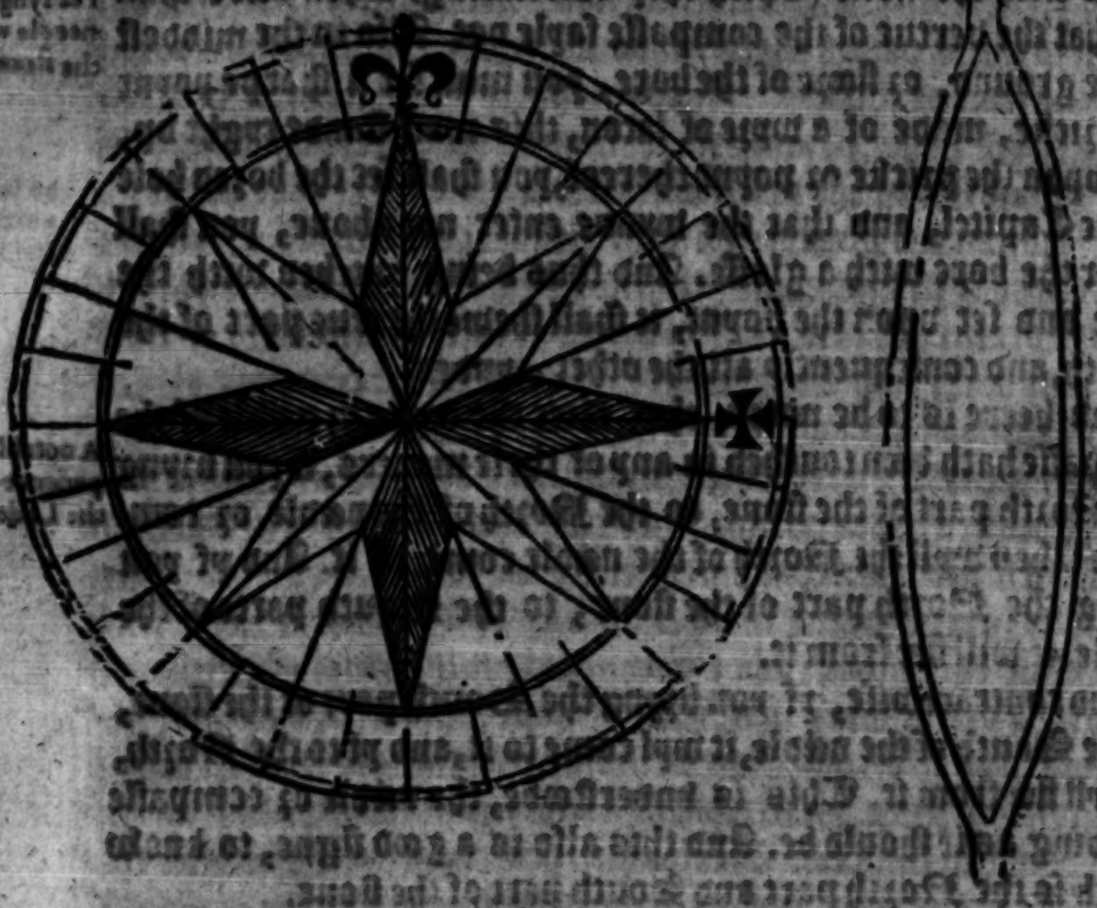
And heere is to be noted, that after the irons or nedle of the compasse hath been touched in any of these maners, if you bryng the North part of the stone, to the North of the nedle or compasse: then wyll the North of the nedle come to it. And yf you bryng the North part of the stone, to the South parte of the nedle, it will flee from it.

A notable experience of the Lodestone.

And contrariwise, yf you bryng the South part of the stone, to the South of the nedle, it wyl come to it, and yf to the North, it wyll flee from it. This is vnderstoode, the nedle or compasse standing as it should be. And this also is a good signe, to know which is the North part and South part of the stone.

Moreouer, this boxe must be put within another boxe, in the which it must hang vpon two circles of laton, annexed the one within the other: whiche serue that the compasse sway not, or hang not toward the one syde or the other, although the Shyp sway, and this boxe also must haue his couer of wood, to keepe the other. You shall lykewyse obserue that the poynt of the Capitell, and the hole thereof, and also the poynt or prick vpon the which it resteth, by vpright, and lykewyse the Rose, that it decline not to one part or other. And if it be quicker then it ought to be, then make the poynt that it goeth vpon somewhat blunter.

The



¶ The v. Chapter, of the effect or propertie, that the compasse hath to the Northeasting or Northwesting, whereby is knowen the variation of the Compasse.

The variation of the compas.

MAny and dyuers are the opinions that I haue hearde, and also read in certayne wryters of latter dayes, as touching the Northeasting and Northwesting of the Compasse, and yet mée seemeth, that none dooth touche the prycke, and fewe the whyte.

They call it Northeasting, when the

néedle

nǽdle sheweth or poynteth from the North (which is his true marke) toward the Northeast: and Northwesting, when from the North, it declyneth towarde Northwest. For the better vnderstanding of these differences, whereby the nǽdles differ or vary from the pole, you must (being in the Meridian where the compasses shewe the pole) imagine a poynt vnder the pole of the world, and this poynt to be without all the heauens, conteyned vnder the fyrst moueable. The which poynt or part of heauen, hath a vertue attractiue, ẏ draweth vnto it Iron touched with the part of the lode stone, correspondent to that certayne part of heauen imagined without or vnder al the heauens, moued by ẏ fyrst moueable. For if it were imagined to be moued within any of the moued heauens, then the attractiue point, by the mouing of the first moueable, & consequently the compasse, should make the selfe same mouing in 24. houres, which is neuer sǽne. And therefore this poynt is not in the moueable heauens, neither in ẏ pole. For if it were in it, the compasse should not vary, Northeasting, and Northwesting. Therfore the cause of Northeasting or Northwesting, or departing from the pole of the world, is, that being in the sayd Meridian, the attractiue poynt and the pole, are in the selfe same, or in one Meridian: and the compasse shewing the attractiue poynt, sheweth directly the pole. And departing from the same Meridian toward the East (the worlde being round) the pole of the world remayneth to vs on the left hand: and the poynt of the attractiue vertue, shalbe on the right hand, which is toward the Northeast winde. And in how much more we shall sayle toward the East, the distaunce shall appeare greater vnto vs, vntill we come vnto the 90. degrées: and there shalbe the most and greatest Northeasting. And passyng from thence further forward, it shall appeare vnto vs, ẏ the attractiue poynt, commeth nǽrer & nǽrer vnto the Meridian line: and so much shall the compasse go bettering or amending the Northeasting, vntil it returne to the self same meridian in the opposite or contrary part from whence they came, or where they began, & then shall the attractiue point be to them directly vpō, or against the pole of the world, & the compasse shall shew or point directly toward it. And againe, passing further forward, the pole of the

The poynt attractiue imagined vnder the pole of the world.

The cause of the variation of the compas

Departing of the pole from the poynt attractiue.

The greatest Northeasting.

world shal remnue to the right hand, and the point attractiue to the left hand, and so shall the compasse begin Northwesting, increasing it vntil it come from thence to the 90 degrees, & there shalbe the most of his Northwesting. For turning towarde the Meridian from the attractiue point, it shall go amending or bettering, vntil it returne to the selfesame Meridian from whence it departed, & there shal the compasse shew the pole of the world directly, by, or ouer against the attractiue point, which is perpendiculerly vnder the pole. And if frō thence they should turne, to passe toward the West, the pole should rest to the right hand, & the attractiue point to the left, & so shall the variation be to the Northwest: and this is the cause of the Northeasting, & Northwesting, or variation of the compasse. Also it is not to be vnderstoode that this Northeasting, & Northwesting, is vniforme, as is the departing (or according to the departure) from the Meridian, where the compasse sheweth perfectly: but rather before at the beginning of the departing from the sayd Meridian, it maketh differēce, or variation in a certaine quantitie, & the increase that is afterward, is litle, and so much the lesse, in how much ẏ more the departing is frō the said Meridian. For it is a passion of ẏ circles, deuiding or cutting them selues in ẏ sphere: so that these differences are, as are they of the declinatiōs of the Sun: which neere vnto the Equinoctials, are great, & neere to the solstitials, are litle. All the which shal euidently appeare in ẏ figure folowing, which is a circle deuided by two Diameters, into 4. equal parts, cutting thē selues in ẏ center in right angles. And from the center point (called the pole) cōmeth forth a moueable Meridian: & in it goeth a compasse likewise moueable about the circle. The attractiue poynt is somwhat distant from the pole of the world, & from it, commeth forth a threede, which must euer passe by the North & South of the compasse. And the compasse being in the Meridian of ẏ point attractiue, that passeth by the pole, shall shew the pole. And without that shal go northeasting, or northwesting, so varying & departing frō the true Meridian that commeth forth of the pole of the world. It is the opinion of some Mariners, that the Meridian where the compasse sheweth directly the pole, passeth by the Iland of Sancta Maria, & other say, by the Iland of Cueruo in the Asores.

The greatest northwesting.

The attractiue point is vnder the Pole.

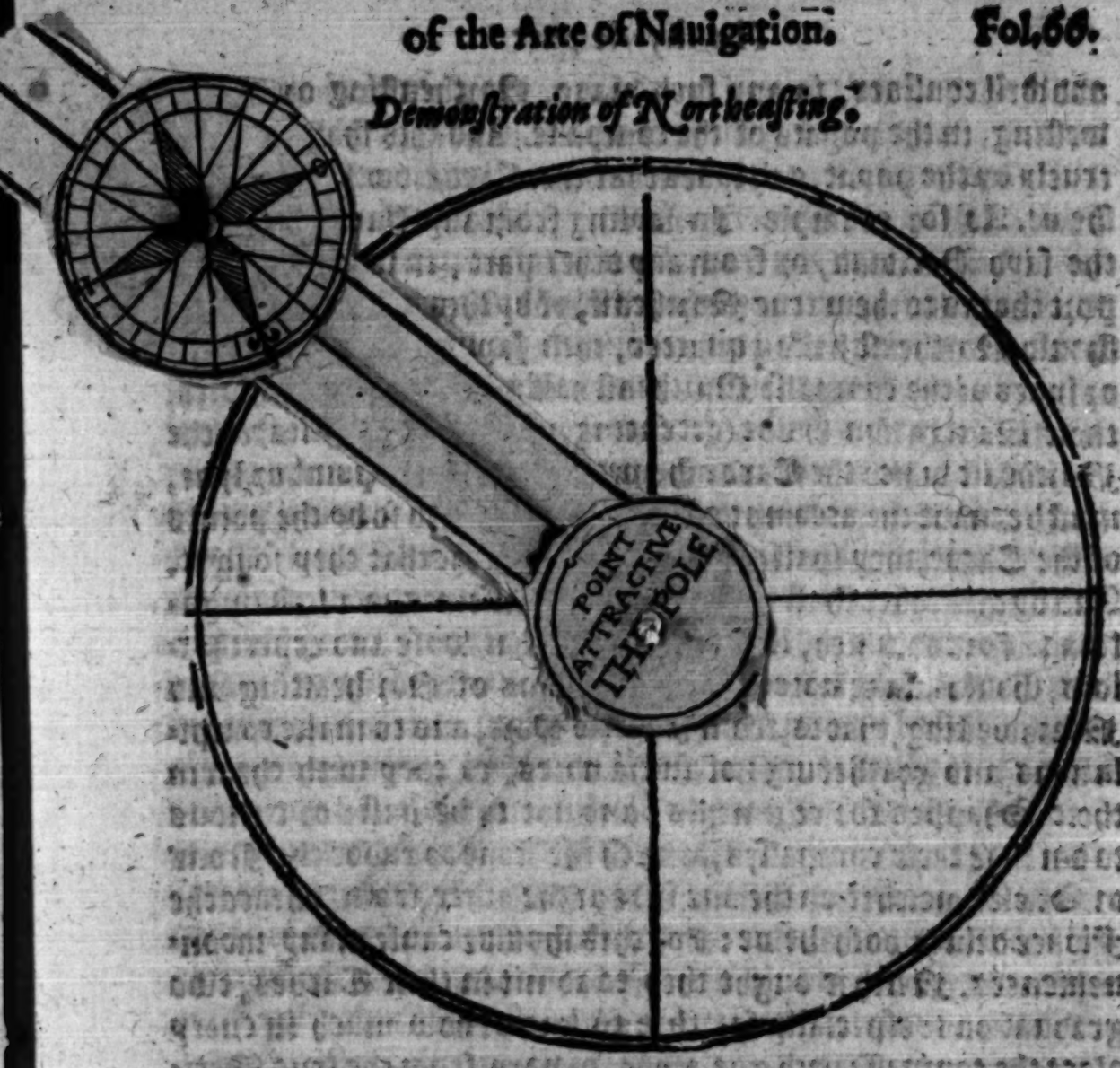
The Northeasting & North westing is not vniforme.

The declination of the Sun.

The Meridian that sheweth the Pole.

De-

Demonstration of Northeasting.



And where as the inconuenience is manifest and notorious, the same must be remedied with prudence and tyme, and not to be negligent in the viage: but euer to vse & obserue experience, more profitable then the subtyle and curious questions of the secrete searchers of naturall things without experience, wherof reason taketh his principall grounde. And therefore the wyse Pilot ought to knowe by experience (as many of them doo not) how much a good compasse doth vary, Northeasting, or Northwesting from one Port to another. So that to know how much the compasse doth vary, Northeasting, or Northwesting, from one place to another (as to say, halfe a quarter, or more or lesse in quantitie as they are distant from the said Meridian, where the compasses shew the Pole) shall in the Nauigation take heede,

Experience, the ground of reason.

Aduertisement to Pilots.

and well conſider, in any ſuch viage, Northeaſting or Northweſting, in the poynts of the compaſſe. And this ſhalbe to ſayle truely by the poyntes or lynes that the Carde doth certaynely ſhewe. As for example. In ſayling from any Iſlande that is in the ſayd Meridian, or from any other part, in ſeekyng of any port that is to them true Northeaſt, yf by this way the compaſſe ſhould Northeaſt halfe a quarter, then ſaylyng by the poyntes or lynes of the compaſſe Northeaſt half a quarter to the North, their Nauigation ſhalbe (excepting other impediments) to the Northeaſt which the Carde ſheweth: And by this point or lyne, muſt be made the accompt of ſuch a vyage. And ſo by the poynts of the Carde, they ſhall directly fynd the Port that they ſought. And by this order ſhall they gouerne themſelues in all Nauigations. For the which, it is conuenient that wyſe and expert Pilots, ſhould make notes of obſeruations of Northeaſting and Northweſting, that is, from Port, to Port, and to make compilations and geatherings of ſuche notes, to cary with them in their Shyppes for regiments: and not to be buſie or curious to amende their compaſſes, or with the ſtone to rubbe the Irons or Needles, neither on the one ſyde or the other, from whence the Floure delice doth ſhewe: For this ſhoulde cauſe many inconueniences. Neither ought they to admit in their Cardes, two graduations: eſpecially for that to knowe how much in euery place the compaſſe doth goe aſyde, or vary from the true Meridian, may eaſely be made an inſtrument to ſhew the ſame by the Sunne in the day, and by the Starres in the nyght.

Example of ſaylyng.

The variation of the compaſſe.

The vi. Chapter, of the introduction and principles of the Arte of Nauigation.

FOr as much as now we haue the guyde, whiche is the compaſſe, it is conuenient to enter into the way, which is Nauigation. The which (as we haue ſayde) is to goe or paſſe by water from one place to another. And this preſuppoſed, I ſay that he that deſireth to attempt Nauigations, muſt knowe two thinges, which

the

the Carde shall shewe him. The one is, by what poynt or lyne he ought to sayle: and this shall the lynes of the sayling Carde shew him. The other is, the leagues of the distaunce: and this shall the scale or trunke of the leagues shewe, taking with a compasse the distaunce of two places, and applying it to the scale. The knowledge of these two things, ought the Pilot to beare in memory: and to put them in effect, ought to direct his foreship to the selfesame wynde, which the compasse doth shewe. For the distaunce, he ought to knowe how much the Ship goeth dayly, wel considering and obseruing the windes, tydes, currents, and all suche thynges as may be with hym, or against him. And according hereunto, he shall knowe howe muche he hath gone, and what remaineth for hym to goe, and whether he be farre off, or neere unto the place whither he intendeth to sayle: the which in Nauigation, is the ende desired. And because this estimation or computation can not be iust & exact, especially in a long voyage, or in long tyme, it shalbe conuenient that we rectifie or amend it, knowing the place where the Ship is, on the superficiall part of the water, by the place that answereth to it in heauen. This place of heauen, is knowen by the altitude of the pole: and by the altitude of the pole, is knowen the altitude of the Equinoctial: & by the altitude of the Equinoctiall and declination of the Sunne, is knowen ỳ Meridian altitude: and contrary wyse, knowing the Meridian altitude and declination of the Sunne, is knowen the altitude of the Equinoctiall, and by the Equinoctial, the pole, and by the altitude of the pole, is knowen the latitude: and this is the place that is desyred to be knowen. But for as muche as the heauen is moueable from the East to the West, this place is not knowen as a certayne point, but is knowen as a lyne or paralel at a certayne distaunce from the Equinoctiall, and it is knowen in what poynt of this paralel the Ship is, by the altitudes that are taken from heauen: but it is knowen by the lyne that the Ship hath gone, as we wil further declare in ỳ xiii. Chapter, of making a poynt or pricke in the Carde. And in this maner you shall haue rectified the way that the Ship hath gone, and consequently the way that it hath yet to goe.

In Nauigation what is chiefly to be considered.

The distance.

The altitude of the Pole & Equinoctiall.

The Meridian altitude.

To know the place of heauen.

To know the way of the vyage.

Rules to knowe the altitudes.

And forasmuch as these altitudes are so profitable and necessarie, it shalbe needfull to geue rules how we may vse them to our most commoditie. And for this, is presupposed to know, that all places situate on the superficiall part of the earth, and water, eyther they are vnder one Meridian, so that they haue, or where they haue one selfe same longitude, and differ in laticude, or are in one paralell, where they haue one selfe same laticude, and differ in longitude, or are in diuers Meridians and paraleles, where they differ in longitude, and latitude. And I say, that if they haue one selfe same longitude, they saile frō the one to the other, by the lyne of North, and South, and how many degrees doth vary the altitude of the pole and of the Equinoctial in heauen, so many degrees haue they gone by sea, or by land, If two places haue one selfe same latitude, they passe from the one to the other by the lyne of East and West. And in such maner of viage, the altitudes do not profit vs, because there is no variation. If they differ or vary in longitude, and latitude, they sayle from the one to the other by some of the other lynes. But there are more degrées that correspond the way that the Ship maketh, then the degrées that vary the altitudes of the Equinoctial, and the pole. And this difference shalbe greater, in how much the lyne shal draw neare to the East and West: And how muche it shall draw néere to North and South, it shalbe lesse. Of the degrées or leagues that aunswere to euery degrée of the variation of the altitude, we will entreate hereafter in the xii. Chapter.

Longitude and latitude.

Variation of degrees.

how the altitudes are knowen, The fixte Starres. The North Starre. To know the altitudes by the Sunne. The Meridian.

These altitudes are knowen many wayes, but especially by two: as by the Meridian altitude & declination of the Sunne (as we haue sayd) is knowen the altitude of the Equinoctiall, and by it, the altitude of the Pole. The second way, they are knowen by the altitude of some fixt Starre, of those that are not hid. And among many other, the North Starre is taken, because it is nearest to the Pole. To know the altitudes by the Sun, three things are necessarie, that is to say, an instrument, the declination of the Sun, and rules. The instrument to knowe the Meridian altitude shalbe the Astrolabie, because it is most commodious for this purpose, whereof we wyll entreate in the

Chapter

Chapter folowing. The declination of the Sunne (which is to take it away, or to ioyne it with the Meridian altitude) we haue already described in the third Chapter of the secons part. The rule to knowe when the declinations must be ioyned with the Meridian altitude, or taken from it, we will geue in the viii. Chapter. To knowe the altitudes of the Pole, by the altitudes of the North Starre, two things are necessarie: that is, an instrumeut, and rules. The instrument wherewith the Mariners are accustomed to take the altitudes of the North, they call Balestilia, which is a crosse staffe, whereof we will write hereafter in the nienth Chapter. And the rules of the Turne or compasse, which the North Starre maketh about the Pole, we wil declare in the tenth Chapter.

The declination of the Sunne.

The altitudes of the Pole.

Iacobs staffe.

¶ The viii. Chapter, of the making and vse of the Astrolabie, with the which the maryners take the altitude of the Sunne.

TAke a plate of copper, or latton (which for this purpose is better then any other mettall) of the biggenesse that you desire to make the Astrolabie, and is commonly of the biggenesse of a spanne of the Diameter, and let it be of the thicknesse of halfe a finger at the least: for the waighter that it shalbe, so much shall it be more steadie to make the altitude. This place must be made round by a circle, leauing comming forth of the circle or corner, in the which you shall put a ring or handel with a hole, whereby you may hang the Astrolabie, by a thred or line to take the altitude.

After it is thus made, with ỹ ring or handle annexed thereto, make it bryght, and smoothe, publyshed on both the sydes, and all of one equall thicknesse, that one syde be not heauier then another, which yᵉ u shall try in this maner: hang the plate by the ryng or hole that you haue made, and from the same hole hang a plomet of leade, fasted to a heere, or fyne threede of silke. The Astrolabie thus hanging, free, and at libertie with the plomet, if then the threed fal vpon the center of the Astrolabie, it is wel: but yf the threede dw leane or swarue to the one side, or to the other, from the center, then is that side thicker and heauier then the other, and must therefore be made thynner, vntyll the threed fall iustly vpon the center. This done, make a circle vpon the sayde center, a litle within the circumference of the Astrolabie. Then draw a Diameter frō the center of the hole, in the which the ring or handle is, vnto ỹ center of the Astrolabie, trauersing or ouerthwarting the whole Circle. And this shalbe called the line of the Zenith, or Uertial poynt: which also shalbe cut with an other Diameter vpon the center, making right angles with it. And this Diameter shalbe called the Horizontall line. These two Diameters shal deuide the circle, into foure equall partes. After this, you shall make another circle, so much more within the second, that betwene the circumferences of both the circles, may bee conteyned the numbers of the degrees. Then (the Astrolabie hanging before you) you shall deuide the one part (being the superiour and leaft part) fyrst into three equall partes, and euery part shall conteyne 30. degrees. Then shall you deuide euery part of these into three other equall partes, and they shall conteyne 10. degrees: and euery of these deuide into two partes, and they shall conteyne 5. degrees. This done, put a ruler vpon the center of the Astrolabie, applying it to euery of the poyntes that deuide the sayde partes, and drawe certayne lynes that passe from the circumference of the first circle, vnto the lesse circumference: and in the spaces of the lesse circle write the numbers of the degrees, beginning in the Horizontall lyne: and in that space put fiue, and in the second, ten, and so forth of the other, vntyll the 90. degrees ende in the lyne of the Zenith. Then shal you deuide the spaces that are betweene the fyrst circle

The rectifying of the Astrolabie.

The threed and plomet.

The lynes vertical & horizontall.

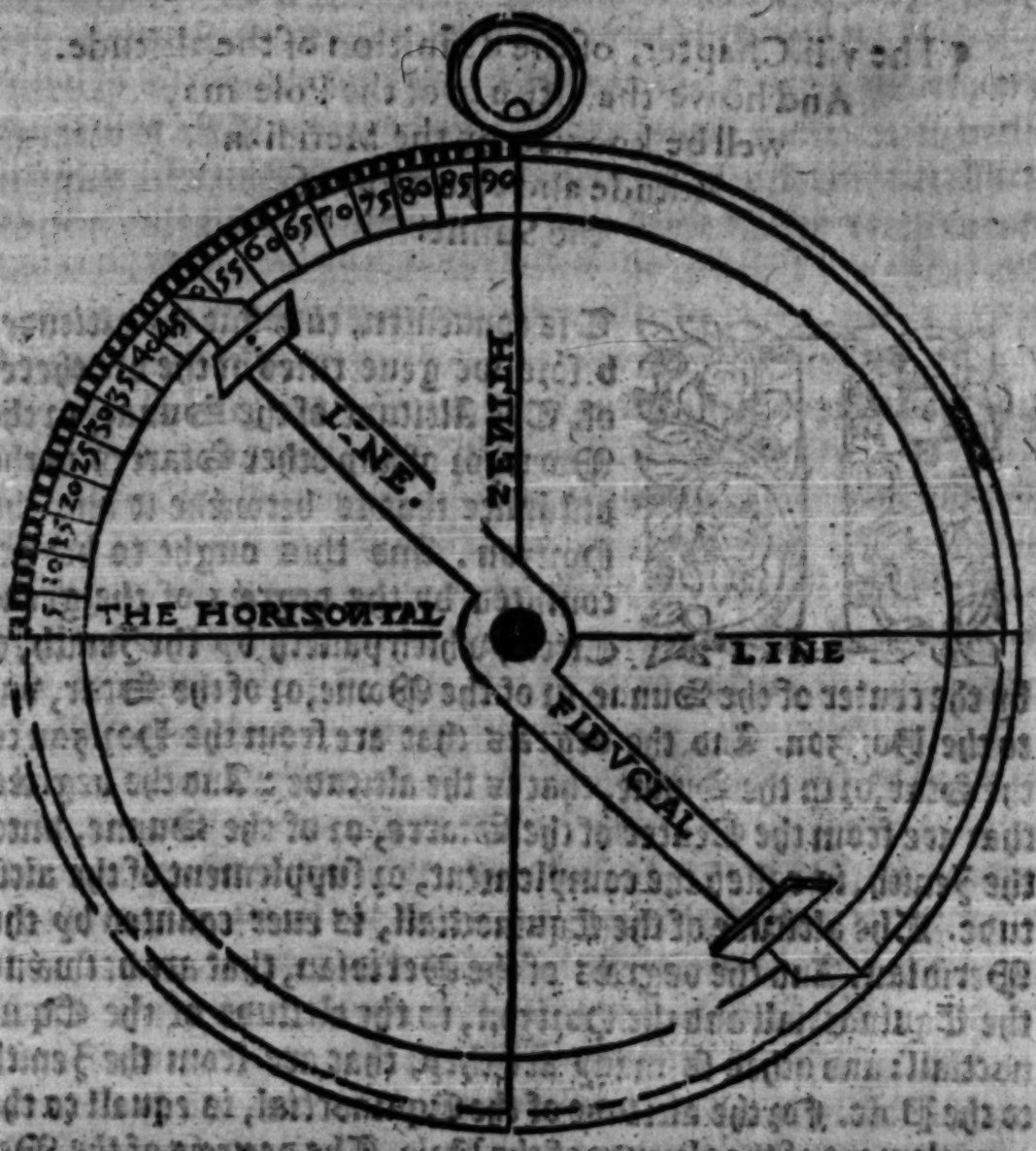
and

and the second, euery space into fyne, which shall make the 90. degrées. The Astrolabie thus made, you shall make the Alhidada or Label. For the whiche, you shall take a plate of laton, of the breadth of scarcely two fingers, and as thicke as the Astrolabie: also as long as the Diameter of the Astrolabie, and make a lyne in the myddest thereof by the longitude: in the middest of this lyne, make a circle, so great, that it may touch in the sides of the plate: then cut off this plate on the one side, that which it hath from the lyne to the ryght hande, and on the other syde, that it hath from the lyne to the leaft hand, leauyng the circle whole. This lyne that shall passe by the center of the circle, is called Linea fiduciæ, (that is) the lyne of confidence, which is that, that sheweth in the degrées, the altitude that is taken. Then shall you take away the endes or corners of the Alhidada that are without the lyne, so that you touche not the lyne. This done, you shal make two litle rysing or raised tables or plates, of the same metal whereof the Astrolabie is made, and of the self same thicknesse that is the Alhidada, or lytle lesse, and of the breadth of the Diameter of the circle of the Alhidada, and let them be a thumbe in heyght or breadth. In the myddest of these two places by the heigth, you shal make a lyne. When these are made equal, and al theyr angles right, in euery lyne of these that you haue made, you shal also make two holes, equally distaunt from the sydes or edges of the sayd plates or tablettes. And of the two holes of euery of these little plates, the one hole must be as bigge as may conteyne a great pynne: and these shall serue to take the altitude of the Starres. The other must be so subtile and small as a fyne sowyng nédle: and these serue to take the altitude of the Sunne. They must be made in such maner, that the outward parte of them be bygger, and lesse within, of the quantitie that I haue sayde. These tablets or erected plates being thus made, they must be sothered in the Alhidada, betwene the center & extremities or endes of the same, making in it certayne notches where they may be made faste, and sothered: or leauyng fyrst in the plates certayne sharpe poyntes or corners, that may enter into certayne holes made in the Alhidada, whereby they may be made faste vnderneath with pinnes: And they must

The Alhidada of the Astrolabie.

The holes of the alhidada.

muſt be ſo ſet, that the line where the holes of ꝯ plates are, may fall vpon the lyne of confidence of the Alhidada, ſo that the one halfe of the plate be ſet vpon the Alhidada, & the other half without it, or at large. In like maner you ſhall take good aduertiſement, that the great hole of the one plate, ſtand directly againſt the great hole of the other plate, & be nothing at all awry. This done, you ſhal bore the Aſtrolabie thorough by the center, making a very round hole, that may haue in the middeſt of it the center of the Aſtrolabie. This hole ſhalbe of the biggeneſſe of a goſe quil. And the like ſhal you make in the center of the circle of the Alhidada. Then ſhal you make a pynne or nayle of the ſame laton, the whiche on the vpper part of the Alhidada may haue a playne and round head. This pynne alſo ſhalbe very round and ſmothe, that it may enter iuſt and cloſe into the hole of the Alhidada and Aſtrolabie. And at the end or poynt thereof, comming forth on the other ſide of the Aſtrolabie, muſt be a hole made ſydeway thorough the pinne, cloſe to the plate of the Aſtrolabie, of the bigneſſe of a litle naile or pinne, that may be put therein, to make faſt together the Alhidada with the Aſtrolabie, ſo that the Alhidada may thereby be turned round about the Aſtrolabie, as appeareth in this figure following.



To take the altitude of the Sunne, hang vp the Astrolabie by the ryng, and set the Alhidada against the Sunne, and rayse it, or put it downe in the quarter that is graduate, vntill ỹ beames of the Sunne enter in by the litle hole of the other tablet or raysed plate, and precisely by the other litle hole of the other tablet. Then loke vpon the lyne of confidence: and how many degrees it sheweth in the quarter that is graduate (beginning from the Horizontall lyne) so many degrees of height hath the Sunne. In like maner shall you do to take the altitude of any other Star, looking through the great holes, because this may hardly be seene by the litle holes. To take the altitude of the Sunne.

The

¶ The viii. Chapter, of the definition of the altitude. And howe the altitude of the Pole may well be knowen by the Meridian altitude and elevation of the Sunne.

IT is conuenient to define the altitude, before we geue rules of the vse thereof. The Altitude of the Sunne, or the Moone, or of any other Starres, is the distaunce that is betweene it and the Horizon. And this ought to bee accompted by the degrees of the great Circle, which passeth by the Zenith, & by the center of the Sunne, or of the Moone, or of the Star, vnto the Horizon. And the degrees that are from the Horizon to the Star, or to the Sunne, that is the altitude: And the degrees that are from the Center of the Starre, or of the Sunne, vnto the Zenith, is called the complement, or supplement of the altitude. The altitude of the Equinoctiall, is euer counted by the Meridian. And the degrees of the Meridian, that are betweene the Equinoctiall and the Horizon, is the altitude of the Equinoctiall: and other so many are they, that are from the Zenith to the Pole. For the altitude of the Equinoctial, is equall to the complement of the altitude of the Pole. The degrees of the Meridian that are betweene the Equinoctiall, and the Zenith, is called the complement of the altitude of the Equinoctiall, and is equal to the altitude of the Pole. And although we haue defined the altitude in generall, yet shall we only profit our selues by the Meridional altitude of the Sunne. The Meridian altitude, is the greatest altitude that the Sunne hath euery day: and this shall be, when the Center of the Sunne is in the Meridian. And the Arke of the Meridian, that is betweene the Horizon and the Sunne, is the Meridian altitude. So that when we say the altitude of the Sunne is taken, it is vnderstoode at mydday. The shadowes that the Sunne then maketh, are in three sorts.

What is the altitude of the Planets or Starres.

The complement of the altitude.

From the Zenith to the Pole.

The Meridian altitude of the Sunne.

The shadows that the Sun maketh at mydday.

For

for either to vs it casteth the shadow toward the North part, or toward the South, or perviculer by a right vp line, so that at midday, or noone, nothyng that standeth vpryght, geueth any shadow at all. But forasmuch as there is such variation in declinations, altitudes, shadowes, and paralelles, it shalbe necessarie to geue rules for all variations. And these shalbe reduced into foure briefe and compendious rules the which I haue here described, that the wyttie may haue profite by them, and the rude learne them: not caryng for the rules of the Mariners, because they are so long and tedious. For (as the Philosopher saith) it is vainely done by many, that may well be done by few.

Rules for all variations.

When the shadowe shalbe perpendiculer, it is because the Sunne is in the Zenith, and 90 degrees aboue the Horizon. And then how many degrees of declination the Sunne hath, so much shal we be distant from the Equinoctiall, toward the part where the Sunne declineth. And if it haue no declination, it and we shalbe vnder the Equinoctiall.

The perpendiculer shadowes.

But when the Sunne and the shadowes shalbe to vs from the Equinoctiall, towarde one of the Poles, we shall take away the declination from the Meridian altitude, and then shall remayne the complement of the elevation, which complement being taken from 90. degrees, then shall remayne that which we be distaunt from the Equinoctiall, toward the same Pole.

The declining shadowes.

When the Sunne declineth from the Equinoctiall, towards the one Pole, and the shadowes shalbe towarde the other, we shal toyne the declination with the meridian altitude: and if it come not to 90. then substract them from 90. degrees, and we shall haue the complement, and so much shal we be distant from the Equinoctiall, toward that Pole to the which the shadowe falleth. And yf they be more in number then 90. then the ouerplus of 90. shall we be distaunt from the Equinoctiall, towarde the Pole where the Sunne declineth. And if they be iust 90. we shalbe vnder the Equinoctiall.

When the Sunne hath no declination, we shalbe distaunt frō the Equinoctial the complement of the Meridian altitude, toward the Pole where the shadowes are. By these rules (before the vse whereof we haue spoken) may be knowen how much

VVhen the Sunne hath no declination.

is

is the greatest declination of the Sunne, the altitude of the Equinoctial, the day, houre, and minute, when the Equinox was: the which is knowen as foloweth.

To know the greatest declination of the Sunne.

Hauing taken the greater Meridian altitude of the Sommer (which is in the beginning of Cancer) and the lesse of Winter, (which is in the beginning of Capricorne) taking away the lesse from the more, the rest is that, that is from Tropike to Tropike, & consequently parted by the middest, is the greatest declination. As for example. I suppose, that being in the Citie of Cadiz, to finde the great Meridian altitude of the Sunne (being in the beginning of Cancer) to be 77. degrees, and the lesser Meridian altitude (which is, when the Sunne is in the beginning of Capricorne) to be 30. degrees: then taking 30. from 77. remayne 28. degrees: and so much is frō Tropike to Tropike. And the halfe (which is 23. and a halfe) is the greatest declination.

Example.

Consequently the greatest declination added to the lesse Meridian altitude, taking it away from the greater Meridian altitude, that riseth thereof, is the altitude of the Equinoctiall. Example 23. and a half of the greatest declination, ioined with 30. of the least Meridian altitude, or taken away from the 77. of the greatest Meridian altitude, remayne 53. degrees and a halfe, which is the altitude of the Equinoctiall, in the Citie of Cadiz. Hereof it foloweth, that wt̄ we shal take the meridian altitude in 53. degrees and a halfe, that day is the true Equinoctial. But if it had one day lesse, and the other day folowing it had more, we must take the lesse from the more, & fourme the rule of that vppon the rest, saying, If 24. minutes (which is that that the Sunne declineth in one day) doth yelde 24. houres, how much shall those minutes that lacketh of 53. degrees and a halfe of the altitude of the Equinoctial, yelde me? Multiplying & deuiding accoyding to the foresayd rule, then that which commeth thereof, shall be the houres after the midday, when it is Equinox.

Example.

The true Equinoctial.

Example of the experience that I made in the Citie of Cadiz the tenth day of March at midday or high none, I toke the altitude of the Sunne, in 53 degrees, and 26. minutes, they lacke to be the Equinoctial 4. minutes. An other day, the 21. of

Marche, at noone, I tooke the Sunne, in 53. degrées, and fiftie minutes: which are more then the Equinoctiall by twenty minutes. Then to knowe at what houre the Sunne was in the 53. degrées, and thirtie minutes of the Equinoctiall, I tooke away the Meridian altitude that I tooke at the tenth of March, from that that I tooke at the eleuenth, which is the difference 24. minutes, and I formed the rule, saying: if 24. minutes the Sunne did rise to me, in 24. houres, then in how much time shall ryse vnto me the four minutes that failed me at the tenth of March? I multiplyed, deuided, & found, that in four houres: and so shall you say, that the Equinoctiall was in the citie of Cadiz the tenth day of March, at foure of the clocke at after noone, which is vnderstoode (according to the Astronomers) at foure houres run at the eleuenth day of March, at this present yéere 1545.

The ix. Chapter, of the making of the crosse staffe, wherewith the Mariners take the altitude of the North Starre.

MAke a square staffe or yarde, of the thicknesse of a finger, more or lesse, according to the goodnesse of the wood, and of length sixe spannes, or more. For the longer that it is, the more precise shall it be, and the degrées shall be the greater, whereby followeth the certainetie of the altitude. Then take a very plaine table, of the length of the staffe, and two spannes of breadth, or at the least a spanne and a halfe: and in the myddest of this Table, make a ryght lyne by longitude, and in the one end of this lyne, make another lyne that may cut it in right angles. And vppon the cutting of these two lynes, put the foote of the compasse, and make halfe a circle, which may remayne on the parte of the long lyne, so that the halfe circle may haue so much Diameter, as you desire the

height

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Example.

The true Equinoctial.

Example of the experience that I made in the Citie of Cadiz the tenth day of March at midday or high noone, I toke the altitude of the Sunne, in 53. degrées, and 26. minutes, they lacke to be the Equinoctial 4. minutes. An other day, the 11. of

March,

Marche, at nowe, I toke the Sunne, in 53. degrees, and fiftie minutes: which are more then the Equinoctiall by twenty minutes. Then to knowe at what houre the Sunne was in the 53. degrees, and thirtie minutes of the Equinoctiall, I toke away the Meridian altitude that I toke at the tenth of March, from that that I toke at the eleuenth, which is the difference 24. minutes, and I formed the rule, saying: If 24. minutes the Sunne did rise to me, in 24. houres, then in how much time shall ryse vnto me the four minutes that failed me at the tenth of March? I multiplyed, deuided, & found, that in four houres: and so shall you say, that the Equinoctiall was in the citie of Cadiz the tenth day of March, at foure of the clocke at after noone, which is vnderstode (according to the Astronomers) at foure houres run at the eleuenth day of March, at this present yere 1545.

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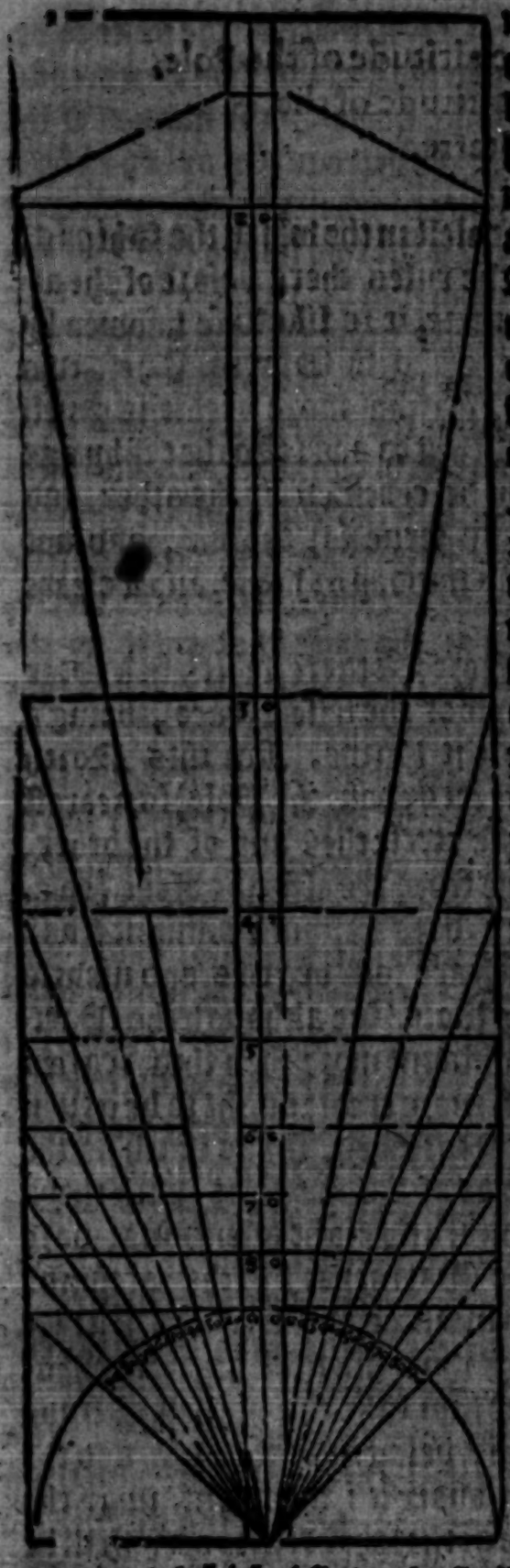
height

height of the hammer, head, or crossepéce of the staffe to be. This halfe circle being made, you shall drawe two lynes, equidistaunt to the lyne which you haue made by the middest of the Table. These lines must touch in the extremities or ends of the half circle. Then deuide euery halfe of ꝑ halfe circle, or quarter of the circle, into two equal parts, & the two halfes that shal end in the first line, deuide eche of them into 90. equall partes. Then take a ruler, and put the edge thereof vpon the center of the half circle, and vpon euery of the marks which deuide the 90. parts, and so procéde, making punctes in the lynes, which you haue made equidistant to the fyrst lyne. Then drawe certayne rygbt lynes, from the punctes of the one lyne, to the opposite punctes of the other: and so shal the draught be ended. Then take ꝑ staffe or yard, & put the one end therof in the center of the halfe circle, and apply the edge of the yarde to the lyne that goeth by the middest of the Table: and marke in the yarde the markes that are in the said lyne, by meanes of the trauersing lynes, and se also that the markes which you make in the yard, be trauersing lynes, and make them their numbers, beginning at the end or poynt of the yarde that shalbe to the contrary part, from that whiche you did in the punct of the halfe circle. And to knowe with what degrées you shall beginne the yarde or staffe, and what number you shal marke in the fyrst lyne of the punct, loke how many degrées are from the circle whiche you deuided betwéne the lyne that goeth to the last marke, and with so many degrées enter, and so consequently shall you place the numbers from fyue to fyue, or from tenne to tenne. When you haue thus numbred the yard, then to make the crosse pece thereof, take a table or planke of good wood, which shalbe so muche in length, as shalbe the Diameter of the halfe circle, & so much in breadth as thrée tymes the thycknesse of the yarde, and of thicknesse two fyngers, or litle lesse. On the one syde also it must bé very playne, and on the other side in the myddest it must haue a square or quadrature of al the thicknes of the plancke, and from the square to the ends, it must be made thinner and thinner, so that it hath in maner the fourme of suche pickars wherewith

mylstones



milstones are pycked. And in the myddest (by longitude and latitude) it must haue a square hole, by the whiche the yarde may enter iust, and make righe angles with the crosse peece. And the poynte of the yarde must enter by the playne syde of the crosse peece, and come fourth of the square syde thereof. To take the altitude of the North Starre, or any other Starre on the Sea (for it serueth not on the Lande, nor for the Sunne, except the Sunne shalbe vaner any thinne cloude, & the horizon cleare) you shall put the head of the staffe to the corner of your eye, rayling it vp, or putting it downe, vntyll the neather part of the crosse peece come with the Horizon: and being so, if the higher part of the crosse peece shall come with the starre, you must looke the playne syde of the crosse peece in what number of degrees of the staffe it falleth, and those degrees shall be the altitude of the Starre: as yf the crosse peece reache not to the Starre, you must bring the crosse peece nearer to your eye, vntyll the one part therof come with the horizon, and the other with the Starre, and the degrees, which it sheweth, shalbe the altitude.

To take the altitude of the Starres.

¶ The x. Chapter, of the altitude of the Pole, knowen by the altitude of the North Starre.

TO knowe the paralell in the which the Shyp is, ouer and beside the rules there before of the altitudes of the Sunne, it is likewise knowen by the altitudes of the Nozth Starre. These two maners are vsed, for that moze credit is giuen to two witnesses, then to one: So that if by one ayse any doubt, the same may be certified by the other, and also because tyme may sometyme serue for the one, and not for the other: as, to haue a cloudy midday oz noone, and a cleare night.

The North Starre. The les beare.

The altitude is taken of the Nozth Starre, which is a Star in the extremitie oz end of the tayle of the lesse Beare, being a constellation, commonly called the Hozne. For this Nozth Starre (of the most notable Starres about the Pole) is neareste vnto it, & shall therfoze shew a lesse circle then any of the other, and so shall his altitude differ litle from the altitude of the Pole.

The horne. The distaunce of the north Starre from the Pole.

This Starre hath declination 85. degrées, and 51. minuts, and the complement to nientie (which are four degrées, and nientie minutes) is his distance from the Pole. And although the Mariners hold opinion, that it is not distaunt moze then thzée degrées and a halfe, yet to my iudgement, moze credit ought to be geuen to the Astronomers, then to the Mariners, for as much as the Astronomers do knowe the places of the Starres, with theyz longitudes, latitudes, declinations, and right assentions, moze perfectly and pzecisely then do the Mariners: For they accompt not onely by degrées, but also by minutes and seconds. But let none deceiue themselues through my opinion. Therefoze, whosoeuer will pzecisely know it, let him take the highest altitude of the Nozth Starre, which is his being ouer the pole, and the lesse altitude, which is his being vnder it: then take away the lesse from the moze, and the halfe of that that remayneth, shall be the distaunce of that Starre from the pole of the wozld.

And

And likewise by this experience, may be knowen the altitude of the pole, and what all the other starres, that goe not downe vnder the Horizon, be distant from it. Joyning the greater altitude with the lesse, and that shall amount thereof, deuided by the halfe, shalbe the altitude of the Pole: and taking away this altitude of the Pole, from the greater altitude of the Starre, or the lesse from the altitude of the Pole, the rest that remaineth shalbe the distance of the Starre from the Pole. And as ỳ Pole is inuisible, it can not be séene or knowen, whē the North Star is higher or lower, except it be by the meane of some other marke: and for this is considered the position of the former Guards, or watch, being one of ỳ two starres called the Guard, which are in the mouth of the Horne. The Mariners haue noted eight positions from the former Guard starre, to the North starre, which answeare to the eight principall windes. And as the Guard is to the North starre according to the placing of these positions, so shall it be higher or lower from the Pole. Let vs here put the common rules which the Mariners vse, to comply with those that are of opinion of the thrée degrées & a halfe. And for the opinion of ỳ Astronomers (which is the distance of 4. degrées, and 9. minuts) I wil hereafter giue a circuler figure with a moueable horne: then the eight wyndes of the eyght positions being marked, and putting the Guarde and the North starre in euery of the wyndes, it shalbe the distaunce that the North starre is higher or lower from the Pole.

The Pole is inuisible.

The two starr called the Guards of the North Starre.

Common rules of the Mariners differing from the Astronomers.

Common Rules.

The forme Guarde being in the East, the North Starre is in one degrée and a halfe vnder the Pole.

The Guarde being in the Northeast, the North Starre is thrée degrées and a halfe vnder the Pole.

The Guarde being in the North, the Starre is thrée degrées vnder the Pole.

The Guarde in the Northwest, the Starre is halfe a degrée vnder the Pole.

The Guarde in the West, the Starre is one degrée and a halfe aboue the Pole.

These rules after the Mariners accompt do holde, but not after the Astronomers accompt, as may appeare in the rules next before.

The Guarde in the Southwest, the Starre is thre degrees and a halfe aboue the Pole.

The Guarde in the South, the Starre is thre degrees aboue the Pole.

The Guarde in the Southeast, the sayd Nozth Starre is halfe a degre aboue the Pole.

The eyght principall winds according to foure lynes.

Note that these eyght wyndes, are made accozding to foure lynes. Whereof two are right, which are Nozth & South, and East & West: and the other two are crooked, which are Nozth-east Southwest, and Southeast Nozthwest. When the Guarde and the Nozth Starre shalbe in the right lyne, it shall appeare cleare how they are: and when they shalbe in the crooked lynes, it may be sene, because the Guards are the one by the other in a ryght lyne.

An instrument to knowe the rising or falling of the North starre from the pole of the world.

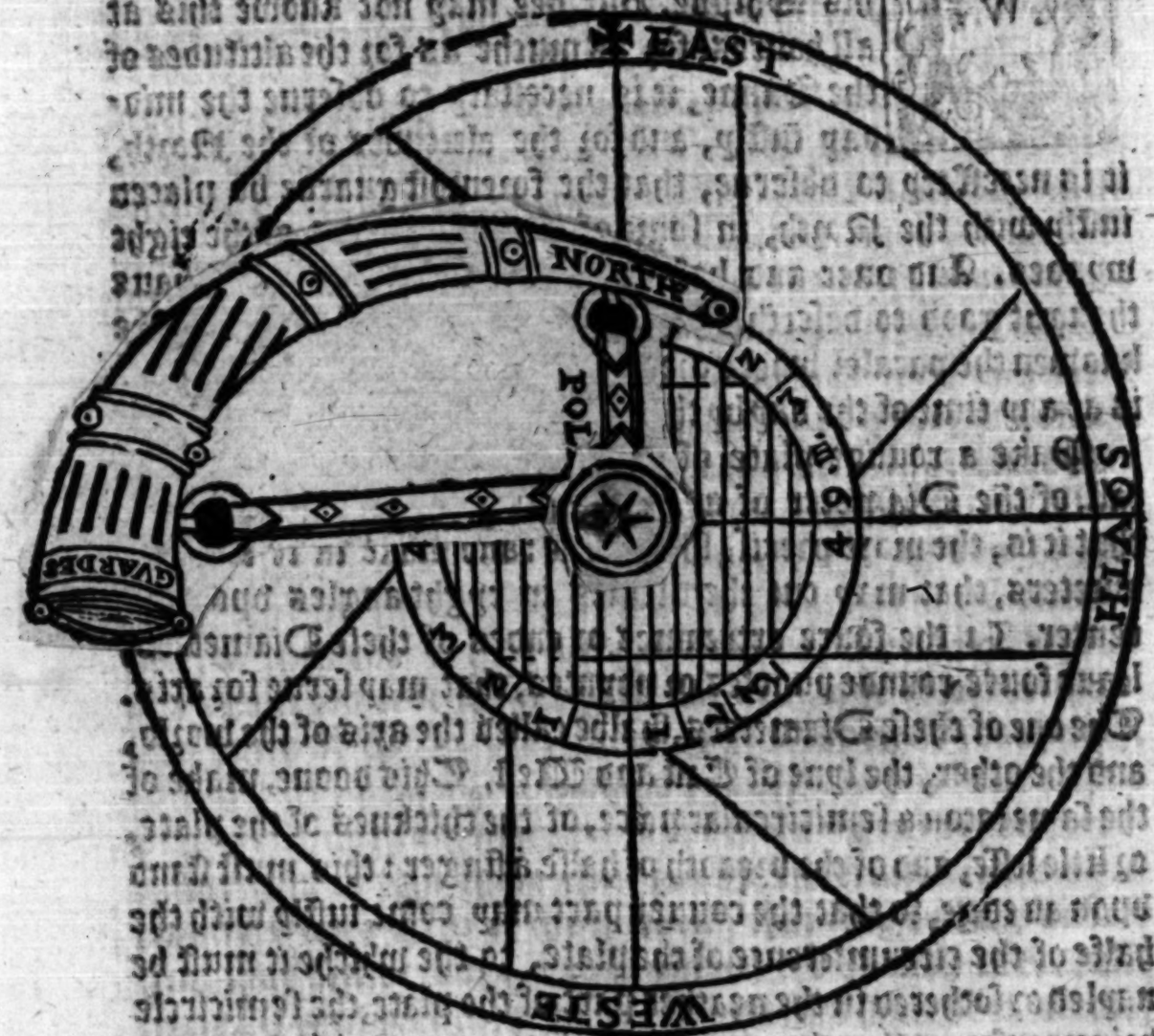
To se by Theozike oz Speculation, how the Nozth starre riseth vp, and goeth downe from the Pole of the wozld, I will here describe the saide circuler figure oz instrument, which is a circle, in whose circumference are writen the eyght wyndes. The Nozth in the highest place of the instrumẽt, which they cal the head, and the South in the neather part thereof, which they call the foote: the East in the right arme, the West in the left arme, the foure rest betweene these in their places. And here is to be noted, that the lines which passe not through ẏ center, are of ẏ wynds of their equidistances that passe through the center. Within this circle, is an other litle circle, which describeth the starre of the Nozth, by the mouing of the first moueable, & hath foz his center the Pole of the wozld, as hath the first. This litle circle hath foz his Diameter eyght degrees and eyghteene minutes: as foure degres and nine minutes aboue the pole, and the other foure degrees and nine minutes vnder it. And they are deuided by certaine lynes equidistant to the East and West. In ẏ center of this circle, is annexed a hozne, with his seuen stars, moueable round about by all the windes. And seeing them in heauen, how, & in what wind they are, euen so in this figure shal we se the Nozth starre, in what part it is of the degrees high oz lowe from the pole: & that the Pilot oz Mariners shall not erre. I say that he ought not to put the fozeguard in the windes that passe

The horne of the seuen starr

Aduertisement to Mariners in vsing the figure following.

paſſe through the center of the figure, for it ſhalbe North and South with the pole, and not with the ſtarre of the North, as it ought to be, and ſo of the other windes. And in this maner the ſtarre of the North, ſhall ſhew in the lynes equidiſtant from the leſſe circle, the degrées & partes of degrées that it is higher or lower then the pole of the world: for the ſame courſe, differences, and variations, it maketh in heauen.

¶ *This figure is after the Aſtronomers, Which affirme that the North ſtarre is four degrees, and nine minutes from the Pole.*



Thus being knowen how muche the North ſtarre is vnder or aboue the pole, let vs take the altitude thereof: and that of it

The altitude of the Pole aboue the horizon.

that is vnder the Pole, let vs ioyne to his height, and as muche of it as is aboue, let vs take away, and that shall rise thereof shall be the altitude of the Pole aboue our horizon.

The xii. Chapter, of the composition and vse of an instrument, by the which without obseruing the South Sunne or mid-day, is knowen the altitude of the Pole and the houre that is.

WE haue geuen rules, whereby the Pilotte may knowe in what paralel he findeth himselfe with his Shippe. But hee may not knowe this at all houres, for as muche as for the altitudes of the Sunne, it is necessary to obserue the mid-day iustly, and for the altitudes of the North, it is necessary to obserue, that the foremost guarde be placed iustly with the North, in some of the foure lynes of the eight wyndes. And ouer and beside the rules aforesaide, I haue thought good to describe an instrument, by the which may be knowen the paralel where the Shippe is, and what the houre is at any time of the day by the beames of the sunne.

An instrument to knowe the paralel and houre by the sunne.

Make a rounde plate of Laton, or other conuenient mettall, of the Diameter of a spanne, or more: For the greater that it is, the more precise shall it be: and make in it two Diameters, that may cut themselues in ryght angles vpon the center. In the foure extreames or endes of these Diameters, leaue foure rounde pinctes or poyntes, that may serue for axis. The one of these Diameters, shalbe called the axis of the worlde, and the other, the lyne of East and West. This doone, make of the same laton a semicircular pece, of the thicknes of the plate, or litle lesse, and of the breadth of halfe a finger: this must stand vpon an edge, so that the couer part may come iustly with the halfe of the circumference of the plate, to the whiche it must be nayled or sothered in the neather part of the plate, the semicircle being rayled, & that the endes thereof may come with the endes of the axis of the worlde. And this semicircle shal you deuide into two equal partes, and euery halfe into 90. degrees, beginning from

from the halfe poynt towarde the ende of the Axis of the worlde, which are the Poles.

In lyke maner shall you make two circuler peeces, of the bignesse of a peece of foure ryals of plate, which they call rundels, for the houres: these must be made fast in the plate by the Poles of the worlde, whiche may hold or beare them by their centers. And euery of these rundelles must be deuided into 24. equall parts, and although not all, yet the vppermost part of the plate. And aboue in ỳ highest point of these diuisions, you must write 12. because that there it shall shew the midday or noone. And frō thence, the afternoone houres must begin their numbers towarde the West part, and shall ende. 6. houres in the halfe or middest of the ioynt of the circle with the plate. In the other ioynt of the other part, shall begin 6. of the houres before noone, & shal ende 12. at the highest poynt. You must also make another Semicircular peece, of the breadth of a finger, this must be playne or flat, & the concauitie or holownesse thereof, equall to the Semicircle of the edge or syde of the plate, and in the endes muste haue two holes, wherein may iustly enter the poynts that come forth of the circle, for the houres, which are the Poles of the worlde. Also, this Semicircle must haue two lynes, one on the vppermost part, and the other on the neathermost, whiche may deuide the breadth into two equall parts. This halfe circle likewise must be deuided into two equal parts by longitude, with a trauersed line, which shalbe called the Equinoctiall, & from this lyne, to the inwarde part thereof, must be counted 13. degrees and a halfe towarde the one part, and as muche towarde the other parte of the 90. that euery halfe of the circle conteyneth. And at euery part where ende the 13. degrees & a halfe, make a trauersed line, so that from the one to the other, may be 47. degrees. And in this space shall you drawe certayne lynes equidistaunte with them of the middest, that they and the middle lyne, may deuide into 4. equall partes the breadth of the halfe circle. Then looke in the table of the declinations of the sunne, what declination haue the 5. degrees of Aries, and that shall you accompt from the Equinoctiall towarde the one part, and

as much more towards the other, making a lyne that may trauerse that of the mydwest, where that declination both end and touch in the other two lynes. And the same shall you do at 10. 15. 20. 25. and 30. which is the end of Aries, and beginning of Taurus: and then the lyne shal trauerse al the breadth. The like also shall you do to Taurus and Gemini, then in the spaces, write the caractes of the xii. signes, beginning Aries from the Equinoctial, toward the North Pole. And then do Taurus and Gemini end in the greatest declination, beginning Cancer in the other part of it. Then Leo and Virgo do end in the Equinoctial, where shal begin Libra, Scorpio, Sagittarius: and in the other part, Capricornus, Aquarius, and Pisces, shall end in the Equinoctiall where Aries began. This halfe circle must haue an opening, or open place, euen and iust in the mydest from the Equinoctial, vnto somewhat more then the greatest declinations, and must be a litle broder on the inner part, then without: and not so brode as may come to the two lynes, because it would then take away the graduation of the signes. And in this open place must be put a square grayne or stubbe, which on the inner part may come playne with the halfe circle, & on the vter part may come forth a litle, where shalbe nayld a square pece of Laton, of the breadth of the halfe circle. This graine or stubbe being so nayled with the pece, must haue in the mydest a hole, so small, as may receiue a litle pinne, and by the center of this hole, must passe a line, which shal trauerse all the grayne. And this lyne shall serue to put the sunne (which the hole representeth) in the degree of the signe where it is. This halfe circle where it goeth in the circumferences of the rundels for the houres, must be syled on the one side vnto the line that is in the mydest, to marke it, and shew the number of it. For the placyng or setting of this instrument, you must cut a gyrdle or ryng of laton, as thick as the plate, and of the breadth of a fynger, or litle lesse: and so large, that of it may be made a circle somewhat bigger then the plate, so that the plate and the Meridian may easily be conteyned within it. This circle shalbe called the Horizon, which must be deuided into foure quarters.

The caracts of the xii. signes.

The hole that representeth the Sunne.

The placing or setting of the instrument.

In lyke maner must be made two semicirculer pæces, & the

ends

ends of them must be nayled or sothered in the poynts that deuide the quarters of the circle: and deuide the one from the other in two equal parts, making right spherical angles. And in this ioynt of these two peces, must be nayled or sothered a Wastel, the which at the one end is deuided into two braunches or forks. Then shal you make a base or foote for the same, which in the vppermost part thereof shall haue a concauitie or holownesse, where may be set a sayling compasse or a needle, touched with the Lode stone, and couered ouer with a glasse. And on the highest edges of this base, the two braunches of the Wastel shalbe made fast, and this base, with the Wastel, the halfe circle, and the circle, shalbe all one pece, which shalbe called the seate or frame of the instrument. The Horizontal circle in the ends of one halfe circle, must haue two holes, in the which may enter the Axis that are made in the ends of the lyne of East & West.

The Foote or Base of the instrument.

Also you must take good heede when you sother or make fast the Wastel in the base, that the North and South of the plate or Horizon, come with the North and South of the needle that is beneath, hauing euer respect how much the needle doth vary from the Meridian, by Northeasting or Northwesting. In the ioynt of the two halfe circles vpon the Wastel, must be a poynt (called the index or shewer) which shal shew in the halfe circle, sothered in the place on the neather part, the degrees that the Pole is rayled aboue the Horizon.

The Index or shewer.

For the perfection of this instrument, it shalbe conuenient to set the Horizon very playne and equal at the time of the operation or practising with the instrument, and this may be done in two maners. Whereof the one is, hanging by a fine threde, at the center of the plate, a plomet made somewhat poynted at the neather ende: so that the Horizon standing playne & leuel, the poynt of the plomet may fal vpon the poynt of the index, and this maner is good for the land. But for the Sea, you shall sother the Horizon two Axes, little stubbes or endes comming forth. These shalbe put in the two opposite holes of a circle of mettall made somewhat strong, and this circle must haue other two stubbes lykewyse comming forth, and equally distant from the two holes. These must be sothered or nayled in two holes

The placing of the horizon.

For the Land.

For the Sea.

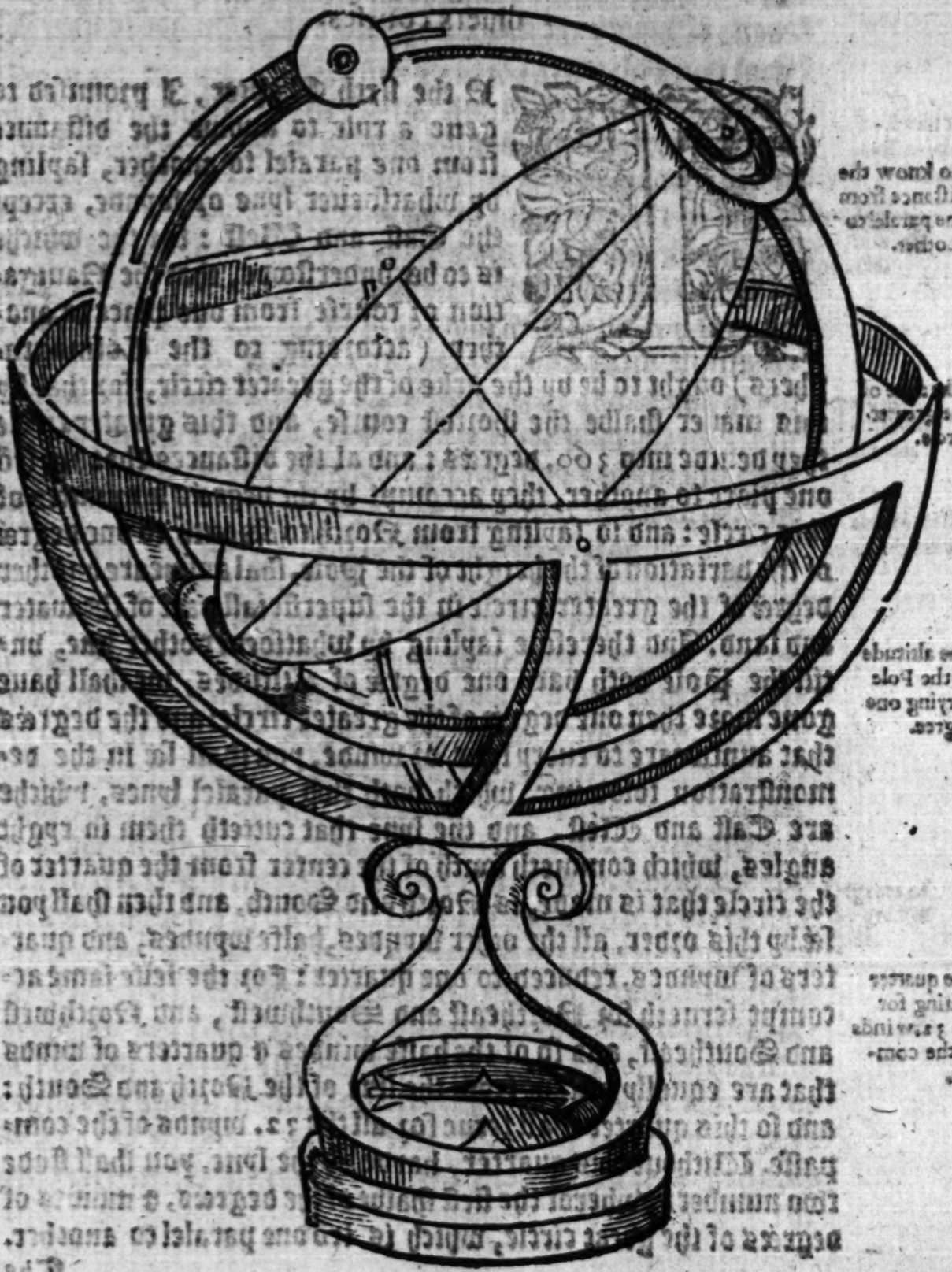
holes of another circle in like maner, and the other circle with other two stubbes, inclosed in a boxe. If then the boxe stand euen and leuel, the poyse or waight shall cause the Horizon to stande leuell, although the Ship sway or roule from side to side. The vse of this instrument is in this maner.

The vse of the instrument.

When you desyre to knowe the paralel in whiche you are, and the houre that is, put the lyne that trauerseth the graine, in the degree of the signe in the which the Sun is (which you shal knowe by the table of the place of the Sunne, in the seconde Chapter of the second parte) and set the North and the South of the place, with the North and South of the needle. Then turne the moueable Meridian against the Sunne, the foote of the instrument standing fast, and rayse it, or put it downe in the plate, vntill the beame of the Sunne enter in at the hole of the graine, and fall in the center of the plate, and standing so, behold the index, and how many degrées it sheweth from the Meridian, so much is the altitude of the Pole. Then looke where the moueable Meridian sheweth in the rundel of the houres, and there shall you sée the houre that is.

The altitude of the Pole.

Heere foloweth the demonstration.



¶ The xii. Chapter, of the leagues that are runne for a degree, according vnto diuers courses.

To know the distance from one paralel to another.

IN the sixth Chapter, I promised to geue a rule to knowe the distaunce from one paralel to another, sayling by whatsoeuer lyne or wynde, except the East and West: for the whiche is to bee vnderstoode, that the Nauigation or course from one place to another (according to the Cosmographers) ought to be by the arke of the greater circle, for that by this maner shalbe the shortest course, and this greater circle they deuide into 360. degrees: and al the distances that are frō one place to another, they accompt by the degrees & minutes of this circle: and so sayling from North to South, to one degree of the variation of the height of the Pole, shal answeare another degree of the greater circle in the superficiall part of the water and land. And therefore sayling by whatsoeuer other line, vntill the Pole doth vary one degree of altitudes, we shall haue gone more then one degree of the greater circle: and the degrees that answeare to euery lyne or winde, you shall see in the demonstration folowing, whith hath two paralel lynes, whiche are East and West, and the lyne that cutteth them in ryght angles, which commeth forth of the center from the quarter of the circle that is made, is North and South, and then shall you see by this order, all the other wyndes, halfe wyndes, and quarters of wyndes, reduced to one quarter: For the selfe same accompt serueth for Northeast and Southwest, and Northwest and Southeast, and so of the halfe windes & quarters of winds that are equally distant from the line of the North and South: and so this quarter shall serue for all the 32. wynds of the compasse. Without this quarter, harde by the lyne, you shall finde two numbers, wherof the first shalbe of the degrees, & minuts of degrees of the great circle, which is frō one paralel to another.

The arke of the greater circle.

The altitude of the Pole varying one degree.

The quarter seruing for the 32. winds of the compas.

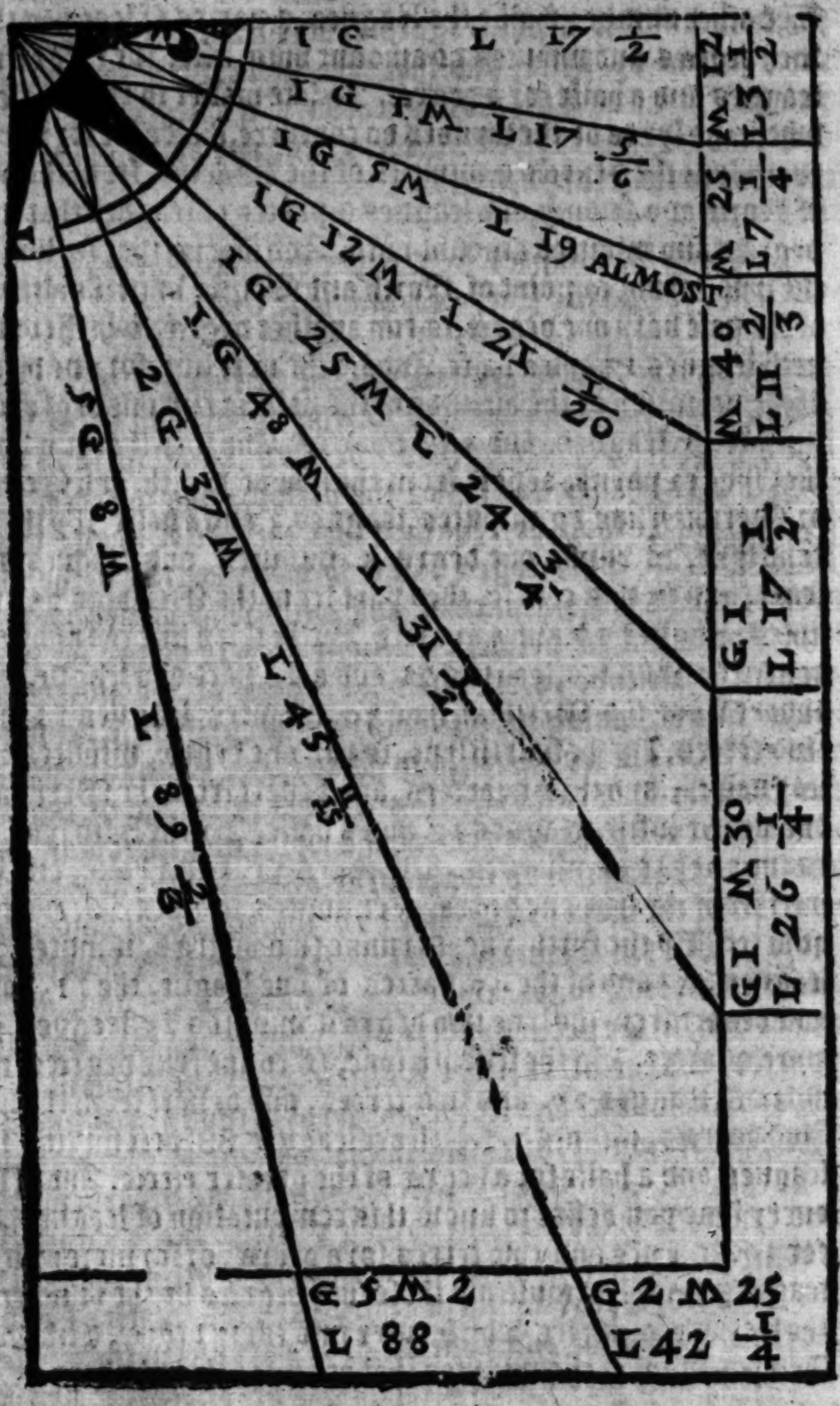
The

The other number, shalbe the leagues, & partes of leagues that such degrées and minutes do amount vnto, after the rate of 17. leagues and a halfe for a degrée. In like maner in the paralell, where the lynes of the wyndes do concurre, shalbe set ioyntly to euery lyne the degrées & minutes of the distaunce from the lyne of North and South, and leagues & partes of leagues that such degrées and minutes amount vnto. And so it is, that sayling by the lyne, wynd, or point of North and South, vntil the altitude of the pole vary one degrée, is run another degrée, which conteineth leagues 17. and a halfe. And by the next line, for one degrée of the variation of the altitude of the pole, is run one degrée, one minute 17. leagues, and 5. fyxe partes. And they that run vpon that lyne or poynt, depart from the lyne of North, and South, or Meridian line 12. minutes, leagues 3. and a halfe. By the second lyne, is runne one degrée 5. minutes, and leagues 19. scant, and in this course, they part from the Meridian 25. minutes, leagues 17. and a quarter. By the third line is runne one degrée 12. minutes, leagues 21. and a 20. part of a league, and depart from the Meridian lyne 40. minutes, leagues 11. and two terces. By the fourth lyne, is run one degrée, minutes 25. leagues 24. and three quarters, and depart from the Meridian, one degrée iustly, leagues 17. and a halfe. By the fyfth lyne, is runne one degrée, minutes 48. leagues 31. and a halfe, and depart from the lyne one degrée 30. minutes, leagues 26. and one quarter. By the fyxth lyne, is runne two degrées, minutes 37. leagues 45. and of the 45. partes of one league, the 11. part, and depart from the lyne two degrées, minutes 25. leagues 42. and a quarter. By the seuenth lyne, is runne fyue degrées, minutes 8. leagues 29. and two terces, and depart from the lyne fyue degrées, minuts 2. which are leagues 88. accompting 17. leagues and a halfe for a degrée of the greater circle. And yf for euery lyne you desire to know this computation of leagues, after 16. leagues and two terces for a degrée, or for more or lesse leagues or myles, multiply those such degrées by the number of the leagues or myles which enter into euery degrée, & likewise shall you number the minutes that are more then the degrées, by the

One degree of variation of the Pole.

Departing from the Meridian lyne.

Degrees of the greater circle.


I G L 17 1/2
I G 1 M L 17 5/6
I G 5 M L 19 ALMOST
I G 12 M L 21 1/20
I G 25 M L 24 3/4
I G 48 M L 31 1/2
2 G 37 M L 45 11/15
5 G 8 M L 89 2/3
M 12 L 3 1/2
M 25 L 7 1/4
M 40 L 11 2/3
G I L 17 1/2
G I M 30 L 26 1/4
G 5 M 2 L 88
G 2 M 25 L 42 1/4

the same number of the leagues that enter in euery degrée, deuiding them by sixtie, and that that shall teme of the diuision, you shall ioyne with the multiplication of the degrées, and that shall amount thereof, shalbe the leagues, and parts of leagues, that was in those such degrées.

The xiii. Chapter, how to set or make a pryeke in the Carde of Navigation.

The Marinors call the pricking of a poynt in the Carde, to sée and appoynt in it, in what poynt or part of the Sea the Ship is in Nauigation. For the performing whereof, it shall be requisite that the Pilot knowe from what degrée, or how many degrées of the altitude of the Pole hée departed, and with what wynde hée sayleth. And when hée desyreth to knowe where he is, let hym knowe the altitude of the Pole, by some of the aforesayde rules. And if (taking the altitude) he fynd him selfe in the same degrées where he was when he departed, his Nauigation hath bèn from the East to the West, and what he hath gone can not be knowen but by the iudgement of a wyse and expert man, according to the swyftnesse or gowdnesse of his Ship, with consideration of the more or lesse time he hath had, as we haue sayd before in the sixth Chapter. But if he fynde him selfe in more or lesse degrées, let him take two payre of compasses, and put the foote of one, in the poynt or place where his Ship was when he departed, and the other in the line or wind by the which he sayleth, and likewise let him set the one poynt of the other compasse in the graduation of the Card, in that number of degrées that he findeth the altitude of the Pole, and the other poynt of the same compasse in the next line of East & West: and so with both the compasses, one in the one hand, and the other in the other hand, let him goe ioyning them tograther, taking good hède, that the poynt of the compasse do not swarue from the wynde whereby he hath sayled, neyther the poynt of the other compasse from the lyne of East and West, where he set it.

To knowe in what part or poynt the Ship is.

The altitude of the Pole.

To fynde the distaunce by the Carde.

And

And folowing those two compasses by these two lynes, vntyll the poynts of the two compasses ioyne (that is to meane, the poynt that was set in the place from whence he departed, and the other that was set in the degrees that were found) then where these two poynts do ioyne, is the poynt where the Ship is. But (as we haue sayd in the syxth Chapter) they must haue great respect to the wyndes and seas, and other things which experience sheweth them, to knowe yf they haue gone directly by that lyne, or yf they haue fallen from it, and to what part: the which I remit to the iudgement of men of good experience. From thence forward, they shall returne to kéepe the same accompt, as when they departed from the hauen, especially when they change their course.

Aduertisments to the Pilotes.

¶ The xiiii. Chapter, of the making and vse of the Instrument generll, to knowe the houres and quantities of the day, and at what winde the Sunne ryseth and falleth.

MAke a rounde plate wyth a ryng or a handle aboue, as in the Astrolabie, drawing a lyne from the ring downeward passing through the center, and another lyne that may cut it in ryght angles through the center: And this last lyne shall be called the Horizon. Then shall you geue a circle vppon the center, leauing so much space betweene it and the edge of the plate, that therein may be written the numbers of the degrees: then also make another circle somewhat more within, leauing lykewyse a space where the graduations may be deuided. This done, deuide one of the highest quadrants towarde the left hand into 90. partes, whiche shall be called the degrees of latitude, beginning the number of them from the ring, and ending the same in the Horizon. Then make another rundell somewhat lesse then this, in such maner that the degrees and numbers of the greater, remayne vncouered.

And

And deuide this lesse, by two Diameters into foure equal partes. And at the one end of the one Diameter, leaue a poynt comyng forth of the lesse rundell, cut directly with the same Diameter by the one part, and this shalbe called the index or shewer. In this rundell you shall make a circle halfe a fynger lesse then the rundel. Then with a compasse take 23. Degrees and a halfe from the Diameter, which signifieth the Equinoctiall: and where as end the 23. degrees and a halfe, for euery part make a ryght lyne from one poynt to another, so that this be a lyne of 47. Degrees, and as much more at the other end of the sayde Equinoctiall. Upon euery one of these right lines, you shall make a halfe circle, and deuide euery of them into fyue equall partes, whiche may aunswere to fyue signes, and euery signe into thyrty partes, which may aunswere to the tenthes or tenth parts of degrees: and if the instrument be great, you shall deuide euery degree into fiue or nine partes, so that you may make it perfect and precise. This done, from the points or prickes of the one halfe circle, to the pointes of the other, draw certaine lynes whiche shalbe equidistant to the Equinoctiall. In the endes of these lynes, betweene the lesse circle, and the edge of the rundell, drawe also certayne lynes, whiche may reache vnto the beginninges and endes of the signes: and in the toppe of the endes, or ouer the endes of these lynes, make an Arke, so farre distaunt from the lesse circle, as is the thicknesse of the edge of a peece of foure ryals of plate: and in the space that is left, graduate the signes from tenne to tenne, or as the diuision shalbe. The space that remayneth from thence to the edge of the rundel, you shal deuide by the halfe, and in it shalbe made twelue spaces, where you shall set the signes with their names or caractes orderly, so that Aries be next vnto the Equinoctiall then Taurus towarde the part of the Index, then Gemini: and turning towarde the Equinoctiall, Cancer, Leo, Virgo. Likewise on the other parte of the Equinoctiall. Libra, Scorpio, Sagittarius. And turnyng to the Equinoctiall, Capricornus, Aquarius, Pisces. And thus hauing signed the Zodiacke, you shall also signe or marke the houres in manner as followeth.

The placing of the twelue signes in the instrument.

The zodiacke.

Deuide the lesse circle of this rundel into foure equal parts, so that euery quarter may haue sixe partes. Reduce this diuision to the Diameter, putting the ruler vpon the poynts, equally distant from the Horizon. And where it toucheth the Equinoctial, make pricks or poynts, so that the Equinoctial remayne deuided into twelue partes. Then vpon one of the Troppykes giue a circle, which may haue the same Tropike for his Diameter. Deuide this circle into 24. equall parts, & reduce these diuisions to the Tropike, as is done in the Equinoctial, & from one Tropike to another: then the Equinoctial and the Tropikes being thus deuided with these pricks or poynts, you shall passe with a payre of compasses by euery poynt equally ordered from the Horizon, to the one and the other part: and these shalbe called houres, writing in the ends of them theyr numbers, beginning the one part in one, and ending it in twelue. On the other part, begin the one in thoppolite part, and end in twelue. This done, these rundels shalbe brought to their perfection. Moreouer, you shal make a triangle, with a right angle, hauing two equal sides that may make the right angle. Euery of these sides must be as long as is the Semidiameter of the greatest rundel: also, vpon and about the ryght angle, you shall make a litle circle, whiche shall haue the same angle for his center, & on the one side of this tryangle, set two rayled plates, as in the Astrolabie: on the contrary side of these rayled plates, must be a hole, so farre distant from the center or angle, as is the Semidiameter of the circle of the lesse rundel. In this hole you must put a thréd, hanging thereat a little wayght or plommet, only sufficient to hold the thréd straight, so that it cause nothing of the rundels to turne, or the instrument to decline. Furthermore, in a circle as bigge as the lesse of the lesse rundel, you shal deuide into 32. parts the eyght wyndes, and halfe wyndes, and quarters of winds. And being thus reduced to their Diameters (as is done in the Equinoctial) you shal translate them in the sides of the triangle, in the which by the center of his little circle, and by the center of the rundels, all the thræ péces must be made fast with an axes or a nayle, so that they may be turned about close and very iuste. Then put a ring in the handle of the instrument, wherby it may hang,

Diuision of the Equinoctial and Tropikes.

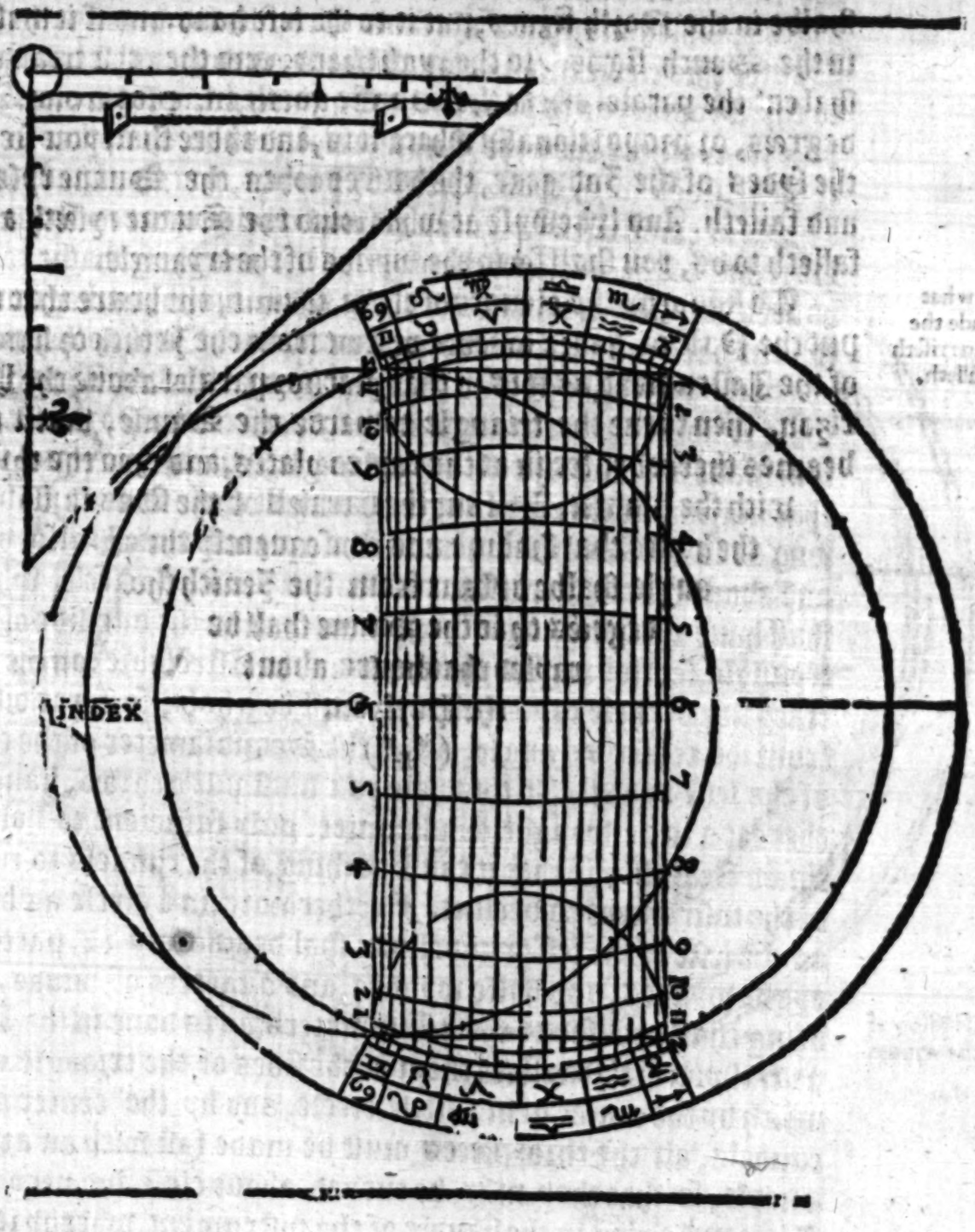
The houres with theyr numbers.

The triangle.

Diuision of the windes.

hang, as in the Astrolabie: and so shall the Instrument be fynished and brought to perfection.

This is the trace or draught of the Instrument.



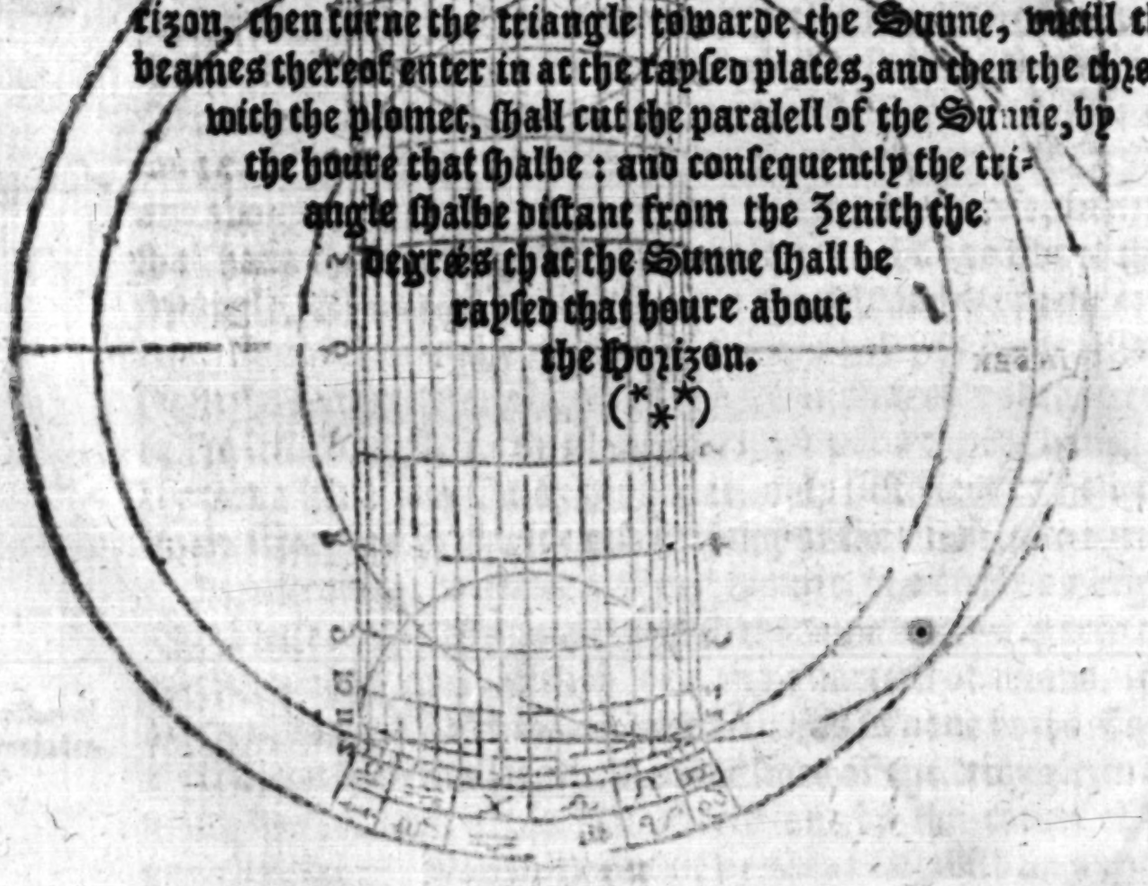
To know at what houre the Sun riseth or falleth.

To knowe at what houre the Sunne ryseth and falleth (by the Instrument folowyng) you shall put the Pole of the lesse rundel (which is the index) to the left hand in the greatest rundell, in so many degrees aboue the Horizon, in how many degrees the Pole is rayled in that lande or place. Then put the tryangle, (which is the Horizon) in his place: that is to say, yf the Sunne shalbe in the North signes, put it to the left hand: and if it shalbe in the South signes, to the ryght hand, and then the triangle shal cut the paralel where the Sunne goeth, in. 10. or. 20. or. 30. degrées, or proportionally where it is, and there shall you see in the sydes of the Zodiacke, the houres when the Sunne ryseth and falleth. And lykewyse at what wind the Sunne ryseth and falleth to vs, you shall see in the wynds of the tryangle.

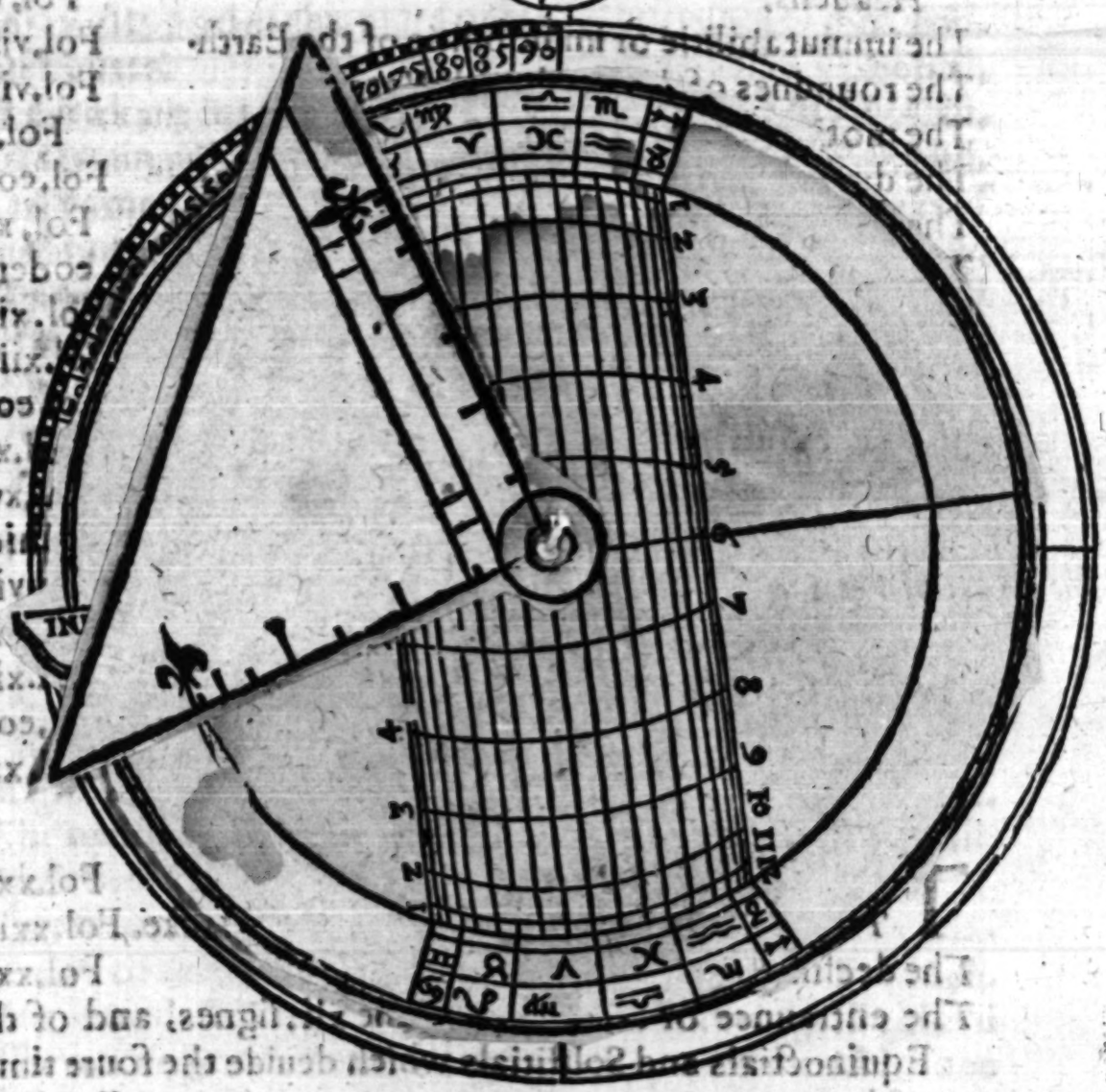
At what winde the Sunne riseth or falleth.

To know by the eleuation of the Sunne, the houre that is, put the Pole or Index so farre distant from the Zenith or handle of the Instrument, as it is in that place or paralel aboue the Horizon, then turne the triangle towarde the Sunne, vntill the beames thereof enter in at the rayled plates, and then the threed with the plomet, shall cut the paralell of the Sunne, by the houre that shalbe: and consequently the triangle shalbe distant from the Zenith the degrées that the Sunne shall be rayled that houre about the Horizon.

(**)



This is the Demonstration.



FINIS.

¶ *Heere beginneth the Table of this Booke.*

The contentes of the Chapters of the *first part.*

THe generall distinction of Creatures, Folio,iiii.
The definition of the World, Fol.v.
The definition of the Sphere, Fol. eodem.
The diuision of the World. Fol. eodem.
The number, order, and propertie of the Elementes and Heauens, Fol.vi.
The immutabilitie or immobilitie of the Earth. Fol.viii.
The roundnes of the Earth and Water. Fol.viii.
The motion of the Heauens and Elements. Fol.x.
The diuision of the Sphere into formall partes, Fol.eod.
The Equinoctiall circle, Fol.xii.
The Zodiacke. Fol. eodem.
The circle called Coluri. Fol.xiii.
The Meridian circle. Fol.xiiii.
The Horizontall circle. Fol.eod.
The foure lesse circles. Fol.xv.
The fiue Zones. Fol.xvi.
The Longitude and Latitude. And of the proportion which the lesse circles haue to the great circle. Fol.xviii.
The circuite or compasse of the earth and water, according to the opinions of the auncient & later auctours, Fol.xix.
The vii. Climates. Fol.eod.
Certayne principles of this science. Fol.xxi.

The Contentes of the second part.

THe course of the Sunne in the Zodiacke. Fol.xxii.
The true place of the Sunne in the Zodiacke. Fol.xxiii.
The declination of the Sunne. Fol.xxv.
The entraunce of the Sunne in the xii. signes, and of the Equinoctials and Solstitials which deuide the foure times of the yeere. Fol.xxvii.
Of the Moone, and her motions and properties. Fol.xxix.
The coniunctions and oppositions of the Sunne and the Moone. Fol.xxx.

The

The declaration and vſe of an inſtrument, by the which is found the place and declination of the Sunne, with the dayes and place of the Moone. Fol.xxxi.
The Eclipſes of the Moone and the Sunne. Fol.xxxiii.
Of tyme, and the definition thereof. Fol.xxxv.
Of the yeere, and the diuers beginnings and reckonings or computations had thereof in olde tyme. Fol.xxxvi.
Of the moneth, and of his differences. Fol. xxxvii.
Of the weeke. Fol. xxxix.
Of the day and night. Fol. eod.
Of houres. Fol. xl.
The making & vſe of an vniuerſall Dyal for the day. Fol.xli.
Of certain perticuler Dials, Mural & Horizontal. Fol. xliii.
The compoſition and vſe of an inſtrument for the houres of the night. Fol. xlv.
The time of the tides, or riſing & falling of the ſea. Fol.xlviii
Of certayne ſignes which prognoſticate tempeſts, or fayre weather. Fol. l.
Of the bright & ſhining exhalations that appere in tẽpeſts which the Mariners call *Santelmo*, or *Corpus ſancti*. Fol. li.

The Contentes of the third part.

THe number, order, and names of the windes. Fol.liiii.
The compoſition of Cardes for the Sea. Fol.lvi.
The vertue and propertie of the Lodeſtone, called in Latin, *Magnes*, and in Spaniſh, *Piedrayman*. Fol.lxii.
The making of the Mariners cõpaſſe for Nauiga. Fol.lxiii.
The effect and propertie that the compaſſe hath to North-eaſting or Northweſting, whereby is knowen the variation of the compaſſe. Fol.lxiiii.
The introductiõ & principles of the art of Nauiga. Fol.lxvii
The making and vſe of the Aſtrolabie, with the which the Mariners take the altitudes of the Sunne. Fol.lxviii.
The definition of the altitudes, and how the altitudes of the Pole may well be knowen by the Meridian altitude and declination of the Sunne. Fol.lxxi.

The

The making of the crosse staffe, wherwith the Mariners take the altitude of the North starre. Fol. lxxii.
How the altitude of the Pole is knowen by the altitude of the North starre. Fol. lxxiii.
The composition & vse of an Instrumēt, by the which without obseruing the South Sunne or midday, is knowen the altitude of the Pole, and the houre that is. Fol. lxxv.
Of the leagues that are run for a degree, according vnto diuers courses, Fol. lxxviii.
Howe to set or make a pricke in the carde of Nauigation. Fol. lxxx.
Of the making and vse of an Instrument generall, to knowe the houres and quantities of the day, and what wind the Sunne ryseth and falleth. Fol. eod.

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Cum Priuilegio.

The Arte of ſhooting in great *Ordnaunce.*

Contayning very neceſſary matters for all ſortes of Seruitoures eyther by Sea or by Lande.

Written by William Bourne.

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